Access DB# 93781

SEARCH REQUEST FORM

Scientific and Technical Information Center

Requester's Full Name: Wesley Markham Examiner # : 76552 Date: 5/12/03
Art Unit: 1762 Phone Number 30 8-7557 Serial Number: 10/042,426
Mail Box and Bldg/Room Location: CP3 10A15 Results Format Preferred (circle): PAPER DISK E-MAIL

If mor than one search is submitted, please prioritize searches in order of need.

****

Please provide a detailed statement of the search topic, and describe as specifically as possible the subject matter to be searched. Include the elected species or structures, keywords, synonyms, acronyms, and registry numbers, and combine with the concept or utility of the invention. Define any terms that may have a special meaning. Give examples or relevant citations, authors, etc, if known. Please attach a copy of the cover sheet, pertinent claims, and abstract.

Title of Invention: Carbon Nanotube Structure having a Catalyst Island

Inventors (please provide full names): Hongjie Dai; Calvin Quate; Hyongsok Soh; Jing Kong

Earliest Priority Filing Date: 8/14/1998

**For Sequence Searches Only* Please include all pertinent information (parent, child, divisional, or issued patent numbers) along with the appropriate serial number.* Index search - dialog - inspec, compendex, CA, SciSearch

Please search Claims 27-37 + 70

especially subject matter of (1) claims 27+28 (forming catalyst particle on a cantilever + then grow carbon nanotube from catalyst particle by CVD) (2) claims 34+35 (pre-reacting carbon containing gas w/ a catalyst before contacting w/ catalyst particle to form nanotube (3) claim 37 - growing nanotube across a trench by CVD.

carbon nanotube synonyms: SWNT, MWNT, CNT, SWCNT, MWCNT, buckytube, Fullerene tube, nanopipe, nanofilament, nanofiber. Thanks a lot!

****

STAFF USE ONLY		Type of Search		Vendors and cost where applicable	
Searcher:	Jon Calve	NA Sequence (#)		STN	
Searcher Phone #:		AA Sequence (#)		Dialog	✓ Index Search
Searcher Location:		Structure (#)		Questel/Orbit	
Date Searcher Picked Up:	5/16/03	Bibliographic	✓	Dr.Link	
Date Completed:	5/16/03	Litigation		Lexis/Nexis	
Searcher Prep & Review Time:	240 min	Fulltext		Sequence Systems	
Clerical Prep Time:		Patent Family		WWW/Internet	
Online Time:	60 min	Other		Other (specify)	

PTO-1590 (8-01)

USPTO

STIC Search Report
EIC 1700

STIC Database Tracking Number: 93781

TO: Wesley Markham **Location:** **May 16, 2003** **Case Serial Number: 10/042426**	**From: John Calve** **Location: EIC 1700** **CP3/4-3D62** **Phone: 703-308-4139** **John.calve@uspto.gov**

Search Notes

Wesley,

I did an "index" search of 295 files, to determine which files were the most appropriate for your search (Inspec, Compendex, Chemical Abstracts, Scisearch).

The bottom line is [redacted] I didn't find [redacted] much art with a relevant date. For example, in chemical abstracts I found 11 good references. The publication dates were all after 1999. The same applies to the other files I searched. For each file, I printed the records with the best dates first, followed by the records w/ dates > 1999.

For claim 37, I searched on trench as well as photolithography…

If you have any questions, please feel free to call me.

John

PS: Thanks for the synonyms (SWNT) and the notes, they were very helpful

```
=> file hca


FILE 'HCA' ENTERED AT 11:21:58 ON 16 MAY 2003
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FILE COVERS 1907 - 15 May 2003 VOL 138 ISS 21
FILE LAST UPDATED: 15 May 2003  (20030515/ED)

  This file contains CAS Registry Numbers for easy and accurate
  substance identification.


=> d his nofile

     FILE 'LCA' ENTERED AT 09:53:58 ON 16 MAY 2003
L1              1 SEA ABB=ON  PLU=ON  NANOTUB? OR SWNT OR MWNT OR SWCNT OR CNT
                  OR BUCKYTUB? OR (FULLERENE# OR NANO#)(2A)(TUB? OR FIBER# OR
                  PIP##### OR FILAMENT?) OR NANOPIP? OR NANOFILAMENT? OR
                  NANOFIBER? OR NANOFIBRE?
L2              0 SEA ABB=ON  PLU=ON  (SINGLE? OR MULTIPLE? OR SINGLEWALL#)(2A)NA
                  NOTUB? OR ?NANOTUB?

     FILE 'HCA' ENTERED AT 09:59:28 ON 16 MAY 2003
L3          11201 SEA ABB=ON  PLU=ON  L1 OR L2
L4           9151 S NANOTUBES/IT
L5          11201 SEA ABB=ON  PLU=ON  L3 OR L4

     FILE 'LCA' ENTERED AT 10:00:26 ON 16 MAY 2003
L6           3790 SEA ABB=ON  PLU=ON  CATALY? OR ACTIVATOR? OR ACCELERANT? OR
                  ENHANCER? OR ACCELERAT!R?
L7           2290 SEA ABB=ON  PLU=ON  CYLINDR? OR CYLINDER? OR TUB? OR PIPE? OR
                  BOWL?
L8          10068 SEA ABB=ON  PLU=ON  SUBSTRAT? OR SURFACE? OR BASE# OR SUBSTRUCT
                  ? OR UNDERSTRUCTUR? OR UNDERLAY?
L9          32337 SEA ABB=ON  PLU=ON  PRODUC? OR PROD# OR GENERAT? OR MANUF? OR
                  MFR# OR CREAT? OR FORM## OR FORMING# OR FORMAT? OR MAKE# OR
                  MADE# OR MAKING# OR FABRICAT? OR SYNTHESI? OR PREPAR? OR PREP#
L10               QUE ABB=ON  PLU=ON  PARTICL? OR MICROPARTICL? OR PARTICULAT?
                  OR DUST? OR GRIT? OR GRAIN# OR GRANUL? OR POWDER? OR SOOT? OR
                  SMUT? OR FINES# OR PRILL? OR FLAKE# OR PELLET? OR BB#
L11          6012 SEA ABB=ON  PLU=ON  GAS? OR VAPOR? OR VAPOUR? OR MIST##### OR
                  FOG?
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L12        4132 SEA ABB=ON  PLU=ON  OXIDE? OR DIOXIDE? OR TRIOXIDE? OR (DI# OR
                TRI#)(2A)OXIDE#
L13           0 SEA ABB=ON  PLU=ON  ATOMIC FORCE MICROSCOPES/IT

     FILE 'HCA' ENTERED AT 10:06:22 ON 16 MAY 2003
L14         939 SEA ABB=ON  PLU=ON  ATOMIC FORCE MICROSCOPES/IT

     FILE 'LCA' ENTERED AT 10:08:18 ON 16 MAY 2003
L15         980 SEA ABB=ON  PLU=ON  MICROSCOP?
L16           6 SEA ABB=ON  PLU=ON  CANTILEVER? OR CANTI(A)LEVER?

     FILE 'REGISTRY' ENTERED AT 10:08:56 ON 16 MAY 2003
                E CARBON/CN
L17           1 SEA ABB=ON  PLU=ON  CARBON/CN

     FILE 'HCA' ENTERED AT 10:09:20 ON 16 MAY 2003
L18      251812 SEA ABB=ON  PLU=ON  L17
L19        7308 SEA ABB=ON  PLU=ON  L5 AND L9
L20     1299856 SEA ABB=ON  PLU=ON  CATALY? OR ACTIVATOR? OR ACCELERANT? OR
                ENHANCER? OR ACCELERAT!R?
L21       28616 SEA ABB=ON  PLU=ON  L20(2A)L10
L22      419703 SEA ABB=ON  PLU=ON  MICROSCOP?
L23        5889 SEA ABB=ON  PLU=ON  CANTILEVER? OR CANTI(A)LEVER?

     FILE 'LCA' ENTERED AT 10:12:35 ON 16 MAY 2003
L24           1 SEA ABB=ON  PLU=ON  ATOMIC##(2A)FORCE##(2A)MICROSCOP? OR
                FORCE##(2A)MICROSCOP?


     FILE 'HCA' ENTERED AT 10:18:29 ON 16 MAY 2003
L25       26370 SEA ABB=ON  PLU=ON  L14 OR L24
L26        1997 SEA ABB=ON  PLU=ON  L5 AND L20
L27          13 SEA ABB=ON  PLU=ON  L26 AND L23
L28          11 SEA ABB=ON  PLU=ON  L27 AND L11
L29          11 SEA ABB=ON  PLU=ON  L28 AND L23
L30           2 SEA ABB=ON  PLU=ON  L29 AND L12
L31           7 SEA ABB=ON  PLU=ON  L29 AND L8
L32           2 SEA ABB=ON  PLU=ON  L31 AND ELECTRIC?
L33           6 SEA ABB=ON  PLU=ON  L29 AND L25
L34          10 SEA ABB=ON  PLU=ON  L30 OR L31 OR L32 OR L33
L35             QUE ABB=ON  PLU=ON  L18 OR C OR CARBON#
L36          11 SEA ABB=ON  PLU=ON  L29 AND L35
L37          11 SEA ABB=ON  PLU=ON  L34 OR L36
                D SCAN

     FILE 'LCA' ENTERED AT 10:22:38 ON 16 MAY 2003

     FILE 'HCA' ENTERED AT 10:24:42 ON 16 MAY 2003
L38          13 SEA ABB=ON  PLU=ON  L27 OR L37
L39          13 SEA ABB=ON  PLU=ON  L38 AND 1999-2003/PY
L40          13 SEA ABB=ON  PLU=ON  L38 AND 2000-2003/PY
L41          11 SEA ABB=ON  PLU=ON  L38 AND 2001-2003/PY
L42        1300 SEA ABB=ON  PLU=ON  L5(2A)GROW?
L43         689 SEA ABB=ON  PLU=ON  L26 AND L42
L44         610 SEA ABB=ON  PLU=ON  L43 AND 1999-2003/PY
L45          79 SEA ABB=ON  PLU=ON  L43 NOT L44
L46          49 SEA ABB=ON  PLU=ON  L45 AND (L23 OR L12 OR L11)
L47           0 SEA ABB=ON  PLU=ON  L46 AND L23
L48          11 SEA ABB=ON  PLU=ON  L46 AND L12
L49          11 SEA ABB=ON  PLU=ON  L44 AND L23
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L50          10 SEA ABB=ON  PLU=ON  L49 AND L15
L51          13 SEA ABB=ON  PLU=ON  L46 AND L15
L52          34 SEA ABB=ON  PLU=ON  L48 OR L49 OR L50 OR L51
L53          34 SEA ABB=ON  PLU=ON  L52 AND L20

     FILE 'HCA' ENTERED AT 10:34:03 ON 16 MAY 2003
L54         971 SEA ABB=ON  PLU=ON  L25(2A)TIP?
L55           5 SEA ABB=ON  PLU=ON  L53 AND L54
                D SCAN
L56          11 SEA ABB=ON  PLU=ON  L53 AND L23
L57          11 SEA ABB=ON  PLU=ON  L56 OR L55
L58          11 SEA ABB=ON  PLU=ON  L57 AND 1999-2003/PY
L59          34 SEA ABB=ON  PLU=ON  L48 OR L49 OR L51
L60          23 SEA ABB=ON  PLU=ON  L59 AND (L54 OR L22)
L61          11 SEA ABB=ON  PLU=ON  L59 AND L23
L62          10 SEA ABB=ON  PLU=ON  L60 AND L23
L63          11 SEA ABB=ON  PLU=ON  L61 OR L62
L64          11 SEA ABB=ON  PLU=ON  L63 AND 1999-2003/PY
                D L64 1 PY
                D L64 2-11 PY
                D L45 PY
                D 2 L45 PY
L65          23 SEA ABB=ON  PLU=ON  L48 OR L51
                D L65 PY
L66           0 SEA ABB=ON  PLU=ON  L65 AND L54
L67          13 SEA ABB=ON  PLU=ON  L65 AND L22
L68           0 SEA ABB=ON  PLU=ON  L65 AND L23
L69          11 SEA ABB=ON  PLU=ON  L65 AND L12
L70          10 SEA ABB=ON  PLU=ON  L65 AND L8
L71          23 SEA ABB=ON  PLU=ON  L67 OR L69 OR L70
                D SCAN

     FILE 'HCA' ENTERED AT 10:43:58 ON 16 MAY 2003
L72           0 SEA ABB=ON  PLU=ON  L45 AND L23
L73           0 SEA ABB=ON  PLU=ON  L45 AND L25
L74          20 SEA ABB=ON  PLU=ON  L45 AND L22
                D SCAN

     FILE 'LCA' ENTERED AT 10:44:33 ON 16 MAY 2003
L75          57 SEA ABB=ON  PLU=ON  MICROLITHOGRAPH? OR LITHOGRAPH? OR
                MICRO(2A)LITHOGRAPH?

     FILE 'HCA' ENTERED AT 10:47:11 ON 16 MAY 2003
L76       44812 SEA ABB=ON  PLU=ON  MICROLITHOGRAPH? OR LITHOGRAPH? OR
                MICRO(2A)LITHOGRAPH?
L77           0 SEA ABB=ON  PLU=ON  L45 AND L76
L78           0 SEA ABB=ON  PLU=ON  L74 AND L76
L79      177823 SEA ABB=ON  PLU=ON  ETCH? OR TRENCH?
L80           0 SEA ABB=ON  PLU=ON  L45 AND L79

    FILE 'COMPENDEX, INSPEC' ENTERED AT 10:56:46 ON 16 MAY 2003
L81       10133 SEA ABB=ON  PLU=ON  L3
L82      216137 SEA ABB=ON  PLU=ON  L6
L83       18353 SEA ABB=ON  PLU=ON  CANTILEVER? OR CANTI(N) LEVER?
L84      444764 SEA ABB=ON  PLU=ON  L22
L85       40723 SEA ABB=ON  PLU=ON  L24
L86          84 SEA ABB=ON  PLU=ON  L81 AND L83
L87           7 SEA ABB=ON  PLU=ON  L86 AND L82
L88           6 SEA ABB=ON  PLU=ON  L87 AND L84
L89           4 SEA ABB=ON  PLU=ON  L87 AND L85
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L90           7 SEA ABB=ON  PLU=ON  L87 OR L88 OR L89
L91           7 SEA ABB=ON  PLU=ON  L90 AND 1999-2003/PY
                D L91 ALL
L92          10 SEA ABB=ON  PLU=ON  L86 AND (L79 OR L75)
L93       80104 SEA ABB=ON  PLU=ON  TIP?
L94           3 SEA ABB=ON  PLU=ON  L92 AND L93
L95           1 SEA ABB=ON  PLU=ON  L92 AND L12
L96           1 SEA ABB=ON  PLU=ON  L92 AND L11
L97          10 SEA ABB=ON  PLU=ON  L92 OR L94 OR L95 OR L96
L98           9 SEA ABB=ON  PLU=ON  L97 NOT L91
L99           9 SEA ABB=ON  PLU=ON  L98 AND 1999-2003/PY
L100         15 SEA ABB=ON  PLU=ON  (L91 OR L98) AND 2001-2003/PY
L101         16 SEA ABB=ON  PLU=ON  L91 OR L97
L102          1 SEA ABB=ON  PLU=ON  L101 NOT L100

     FILE 'SCISEARCH' ENTERED AT 11:05:43 ON 16 MAY 2003
L103       9240 SEA ABB=ON  PLU=ON  L1 OR L2
L104     419954 SEA ABB=ON  PLU=ON  CATALY? OR ACTIVATOR? OR ACCELERANT? OR
                ENHANCER? OR ACCELERAT!R?
L105       6407 SEA ABB=ON  PLU=ON  CANTILEVER? OR CANTI(A)LEVER?
L106     358701 SEA ABB=ON  PLU=ON  MICROSCOP?
L107      25716 SEA ABB=ON  PLU=ON  ATOMIC##(2A)FORCE##(2A)MICROSCOP? OR
                FORCE##(2A)MICROSCOP?
L108         52 SEA ABB=ON  PLU=ON  L103 AND L105
L109          5 SEA ABB=ON  PLU=ON  L108 AND L104
L110          5 SEA ABB=ON  PLU=ON  L109 AND GROW?
L111          4 SEA ABB=ON  PLU=ON  L110 AND L106
L112          3 SEA ABB=ON  PLU=ON  L110 AND L107
L113          5 SEA ABB=ON  PLU=ON  L110 OR L111 OR L112
L114        410 SEA ABB=ON  PLU=ON  L103 AND L107
L115         37 SEA ABB=ON  PLU=ON  L114 AND L105
L116    1080634 SEA ABB=ON  PLU=ON  TIP###### OR PROB?
L117         32 SEA ABB=ON  PLU=ON  L115 AND L116
L118         52 SEA ABB=ON  PLU=ON  L108 OR L115 OR L117
L119         40 SEA ABB=ON  PLU=ON  L118 AND 2000-2003/PY
L120         12 SEA ABB=ON  PLU=ON  L118 NOT L119
                D SCAN
L121         47 SEA ABB=ON  PLU=ON  L118 AND 1999-2003/PY
L122          5 SEA ABB=ON  PLU=ON  L118 NOT L121
L123          7 SEA ABB=ON  PLU=ON  L120 NOT L122
L124          5 SEA ABB=ON  PLU=ON  L109 OR L110 OR L111 OR L112 OR L113
L125          5 SEA ABB=ON  PLU=ON  L124 NOT (L122 OR L123)

    FILE 'WPIX, JAPIO' ENTERED AT 11:13:52 ON 16 MAY 2003
L126       3311 SEA ABB=ON  PLU=ON  L103
L127     481639 SEA ABB=ON  PLU=ON  L104
L128      31706 SEA ABB=ON  PLU=ON  L105
L129      50139 SEA ABB=ON  PLU=ON  L106
L130       1725 SEA ABB=ON  PLU=ON  L107
L131         23 SEA ABB=ON  PLU=ON  L126 AND L128
L132         39 SEA ABB=ON  PLU=ON  L126 AND L130
L133          8 SEA ABB=ON  PLU=ON  L132 AND L128
L134          4 SEA ABB=ON  PLU=ON  L133 AND L127
L135          2 SEA ABB=ON  PLU=ON  L133 AND (L75 OR L79)
L136          5 SEA ABB=ON  PLU=ON  L131 AND (L75 OR L79)
L137          3 SEA ABB=ON  PLU=ON  L133 AND L11
L138          3 SEA ABB=ON  PLU=ON  L133 AND L12
L139         11 SEA ABB=ON  PLU=ON  L133 OR L134 OR L135 OR L136 OR L137 OR
                L138
L140         10 SEA ABB=ON  PLU=ON  L139 AND 2000-2003/PY
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L141          1 SEA ABB=ON  PLU=ON  L139 NOT L140
L142         54 SEA ABB=ON  PLU=ON  L131 OR L132
L143         51 SEA ABB=ON  PLU=ON  L142 AND 2000-2003/PY
L144          3 SEA ABB=ON  PLU=ON  L142 NOT L143
L145          3 SEA ABB=ON  PLU=ON  L144 OR L141
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FILE 'LCA' ENTERED AT 11:20:09 ON 16 MAY 2003

FILE 'HCA' ENTERED AT 11:21:58 ON 16 MAY 2003

=> d L71 1-23 ti

L71 ANSWER 1 OF 23 HCA COPYRIGHT 2003 ACS
TI Carbon **nanotubes**-Fe-alumina nanocomposites. Part I: influence of the Fe content on the synthesis of powders

L71 ANSWER 2 OF 23 HCA COPYRIGHT 2003 ACS
TI Hydrogen desorption and adsorption measurements on graphite **nanofibers**

L71 ANSWER 3 OF 23 HCA COPYRIGHT 2003 ACS
TI Preparation, morphology, and microstructure of diameter-controllable **vapor-grown** carbon **nanofibers**

L71 ANSWER 4 OF 23 HCA COPYRIGHT 2003 ACS
TI Mossbauer study of **catalytically grown** carbon **nanotube**

L71 ANSWER 5 OF 23 HCA COPYRIGHT 2003 ACS
TI **Growth** of carbon **nanotubes** by **catalytic** decomposition of CH4 or CO on a Ni-MgO **catalyst**

L71 ANSWER 6 OF 23 HCA COPYRIGHT 2003 ACS
TI New techniques for the synthesis of nanometer-sized particles for use in carbon **nanofiber growth**

L71 ANSWER 7 OF 23 HCA COPYRIGHT 2003 ACS
TI Crystallization inside fullerene related structures

L71 ANSWER 8 OF 23 HCA COPYRIGHT 2003 ACS
TI Growth of single-layer carbon tubes assisted with iron-group metal **catalysts** in carbon arc

L71 ANSWER 9 OF 23 HCA COPYRIGHT 2003 ACS
TI Well-aligned graphitic **nanofibers** synthesized by plasma-assisted chemical **vapor** deposition

L71 ANSWER 10 OF 23 HCA COPYRIGHT 2003 ACS
TI TEM characterization of calcium-oxygen nanorods

L71 ANSWER 11 OF 23 HCA COPYRIGHT 2003 ACS
TI Preparation of carbon **nanotubes** by reacting CH4 over Ni-**based catalysts**

L71 ANSWER 12 OF 23 HCA COPYRIGHT 2003 ACS
TI Carbon **nanotubes grown** in situ by a novel **catalytic** method

L71 ANSWER 13 OF 23 HCA COPYRIGHT 2003 ACS
TI **Microscopic** growth mechanisms for carbon **nanotubes**

L71 ANSWER 14 OF 23 HCA COPYRIGHT 2003 ACS
TI Large-scale synthesis of aligned carbon **nanotubes**

L71 ANSWER 15 OF 23 HCA COPYRIGHT 2003 ACS
TI **Single**-wall **nanotubes** produced by metal-
catalyzed disproportionation of carbon monoxide

L71 ANSWER 16 OF 23 HCA COPYRIGHT 2003 ACS
TI Metallic **oxide catalyzed growth** of carbon
nanotubes

L71 ANSWER 17 OF 23 HCA COPYRIGHT 2003 ACS
TI Graphite electrodes containing nanometer-sized metal particles and their
use in the synthesis of **single**-walled carbon **nanotube**
composites

L71 ANSWER 18 OF 23 HCA COPYRIGHT 2003 ACS
TI **Catalytic** Engineering of Carbon Nanostructures

L71 ANSWER 19 OF 23 HCA COPYRIGHT 2003 ACS
TI Pyrolytic carbon **nanotubes** from **vapor-grown**
carbon fibers

L71 ANSWER 20 OF 23 HCA COPYRIGHT 2003 ACS
TI **Catalytic growth** of carbon **nanofibers** and
nanotubes

L71 ANSWER 21 OF 23 HCA COPYRIGHT 2003 ACS
TI **Single**-wall carbon **nanotubes growing**
radially from Ni fine particles formed by arc evaporation

L71 ANSWER 22 OF 23 HCA COPYRIGHT 2003 ACS
TI Growth of manganese filled carbon **nanofibers** in the
vapor phase

L71 ANSWER 23 OF 23 HCA COPYRIGHT 2003 ACS
TI The production and structure of pyrolytic carbon **nanotubes**
(PCNTs)

=> d 3,5,6,8,11-12,14,16,17,18,20 cbib abs hitind
YOU HAVE REQUESTED DATA FROM FILE 'WPIX' - CONTINUE? (Y)/N:n

=> d L71 3,5,6,8,11-12,14,16,17,18,20 cbib abs hitind

L71 ANSWER 3 OF 23 HCA COPYRIGHT 2003 ACS
129:178938 Preparation, morphology, and microstructure of diameter-
controllable **vapor-grown** carbon **nanofibers**.
Fan, Yue-Ying; Li, Feng; Cheng, Hui-Ming; Su, Ge; Yu, Ying-Da; Shen,
Zu-Hong (Institute of Metal Research, Chinese Academy of Sciences,
Shenyang, 110015, Peop. Rep. China). Journal of Materials Research,
13(8), 2342-2346 (English) 1998. CODEN: JMREEE. ISSN: 0884-2914.
Publisher: Materials Research Society.
AB Pure **vapor-grown** carbon **nanofibers** (VGCNF's)
with controllable diams. of 10-200 nm were prepd. by an improved floating
catalyst method. Through transmission electron **microscopy**
(TEM) observation, it was found that VGCNF's have a duplex structure, a
hollow and high-crystallinity graphite filament called primary carbon

fiber surrounded by a pyrocarbon layer with low graphite crystallinity. It was obsd. using high-resoln. TEM that VGCNF's have excellent graphitic crystallinity with graphite layers stacked neatly parallel to fiber axis. Moreover, x-ray diffraction results showed that the graphitic crystallinity of carbon fibers became higher with decreasing diam. of carbon fibers.

CC 57-8 (Ceramics)

ST carbon **nanofiber vapor growth** property

IT **Nanotubes**
RL: PEP (Physical, engineering or chemical process); PRP (Properties); SPN (Synthetic preparation); TEM (Technical or engineered material use); PREP (Preparation); PROC (Process); USES (Uses)
(carbon, **nanofibers**; prepn., morphol., and microstructure of diam.-controllable **vapor-grown** carbon **nanofibers**)

IT Carbon **fibers**, preparation
RL: PEP (Physical, engineering or chemical process); PRP (Properties); SPN (Synthetic preparation); TEM (Technical or engineered material use); PREP (Preparation); PROC (Process); USES (Uses)
(**nano**-scale; prepn., morphol., and microstructure of diam.-controllable **vapor-grown** carbon **nanofibers**)

L71 ANSWER 5 OF 23 HCA COPYRIGHT 2003 ACS

128:105317 **Growth** of carbon **nanotubes** by **catalytic** decomposition of CH4 or CO on a Ni-MgO **catalyst**. Chen, P.; Zhang, H. -B.; Lin, G. -D.; Hong, Q.; Tsai, K. R. (Department of Chemistry and State Key Laboratory of Physical Chemistry for the Solid Surface, Xiamen University, Xiamen, 361005, Peop. Rep. China). Carbon, 35(10-11), 1495-1501 (English) 1997. CODEN: CRBNAH. ISSN: 0008-6223. Publisher: Elsevier Science Ltd..

AB By using a Ni-MgO **catalyst**, carbon **nanotubes** with small and even diam. could be prepd. from **catalytic** decompn. of CH4 or CO. These carbon **nanotubes** prepd. by this method are more or less twisted, with the outer diam. at 15-20 nm, and the tube length up to 10 .mu.m. The results of XRD measurements and pulse reaction testing indicated that the NiO and MgO components in this **catalyst** precursor formed, due to their highly mutual soly., a NixMg1-xO solid soln. The high dispersion of Ni-species in this solid soln. and the effect of valence-stabilization by the MgO crystal field would be in favor of inhibiting deep redn. of Ni2+ to Ni0 and aggregation of the Ni0 to form large metal particles at the **surface** of **catalyst**, making the carbon **nanotubes grown** on this **catalyst** relatively small and even in size of diam. The exptl. results also indicated that, in the growing process of carbon **nanotubes**, the rate-detg. step was dependent upon the conditions of prepn. (i.e. feedgas used, reaction temp., flow-rate of the feedgas, etc.). The growth mechanism of the carbon **nanotubes** on the Ni-MgO **catalyst** is discussed together with the exptl. results.

CC 57-8 (Ceramics)
Section cross-reference(s): 78

ST carbon **nanotube catalytic vapor growth**; methane **catalytic vapor growth** carbon **nanotube**; carbon monoxide **catalytic vapor growth nanotube**

IT **Nanotubes**
RL: PEP (Physical, engineering or chemical process); PRP (Properties); SPN (Synthetic preparation); TEM (Technical or engineered material use); PREP (Preparation); PROC (Process); USES (Uses)
(carbon; **growth** of carbon **nanotubes** by

catalytic decompn. of CH4 or CO on a (Ni,Mg)O **catalyst**
)

IT 74-82-8, Methane, processes 630-08-0, Carbon monoxide, processes
RL: PEP (Physical, engineering or chemical process); PROC (Process)
(carbon source; **growth** of carbon **nanotubes** by
catalytic decompn. of CH4 or CO on a (Ni,Mg)O **catalyst**
)

IT 1309-48-4, Magnesium **oxide** (MgO), uses 1313-99-1, Nickel
oxide nio, uses 144228-60-4, Magnesium nickel **oxide**
RL: CAT (Catalyst use); USES (Uses)
(**catalyst**; **growth** of carbon **nanotubes** by
catalytic decompn. of CH4 or CO on a (Ni,Mg)O **catalyst**
)

IT 7440-44-0P, Carbon, preparation
RL: PEP (Physical, engineering or chemical process); PRP (Properties); SPN (Synthetic preparation); TEM (Technical or engineered material use); PREP (Preparation); PROC (Process); USES (Uses)
(**nanotubes**; **growth** of carbon **nanotubes** by
catalytic decompn. of CH4 or CO on a (Ni,Mg)O **catalyst**
)

L71 ANSWER 6 OF 23 HCA COPYRIGHT 2003 ACS

127:235574 New techniques for the synthesis of nanometer-sized particles for use in carbon **nanofiber growth**. Irons, S. H.; Nemchuk, N. I.; Rohrs, H. W.; Kowalewski, T.; Faircloth, B. O.; Krchnavek, R. R.; Ruoff, R. S. (Dept. of Physics, Washington University, St. Louis, MO, 63130, USA). Proceedings - Electrochemical Society, 97-14(Recent Advances in the Chemistry and Physics of Fullerenes and Related Materials), 875-883 (English) 1997. CODEN: PESODO. ISSN: 0161-6374. Publisher: Electrochemical Society.

AB Several novel techniques for synthesizing small metal particles for the **catalytic growth** of carbon **nanofibers** via chem. **vapor** deposition (CVD) are reported. Abrasion of metals on a rough aluminum **oxide surface** will produce metal particles that will **catalyze nanofiber growth**. Ferritin, a biomol., also shows promise as a source of small iron particles for fiber growth. Preliminary results involving the synthesis of a nanoparticle array and the use of C60 as a carbon precursor for the CVD synthesis of carbon **nanofibers** are discussed.

CC 40-2 (Textiles and Fibers)

ST carbon **nanofiber** synthesis metal **catalyst**

IT Ferritins
RL: CAT (Catalyst use); USES (Uses)
(**catalyst** precursor; chem. **vapor** deposition
synthesis of nanometer-sized particles for use in carbon
nanofiber growth in presence of small metal
particles)

IT Abrasion
Catalysts
(chem. **vapor** deposition synthesis of nanometer-sized
particles for use in carbon **nanofiber growth** in
presence of small metal particles)

IT Carbon fibers, preparation
RL: PEP (Physical, engineering or chemical process); SPN (Synthetic preparation); PREP (Preparation); PROC (Process)
(**nanofibers**; chem. **vapor** deposition synthesis of
nanometer-sized particles for use in carbon **nanofiber**
growth in presence of small metal particles)

IT 11109-50-5
RL: CAT (Catalyst use); USES (Uses)

(**catalyst** precursor; chem. **vapor** deposition synthesis of nanometer-sized particles for use in carbon **nanofiber growth** in presence of small metal particles)

IT 7439-89-6, Iron, uses 7440-02-0, Nickel, uses 7440-48-4, Cobalt, uses
RL: CAT (Catalyst use); USES (Uses)
(**catalyst**; chem. **vapor** deposition synthesis of nanometer-sized particles for use in carbon **nanofiber growth** in presence of small metal particles)

IT 74-86-2D, Acetylene, pyrolyzed 99685-96-8D, Fullerene C-60, pyrolyzed
RL: PEP (Physical, engineering or chemical process); PROC (Process)
(fiber precursor; chem. **vapor** deposition synthesis of nanometer-sized particles for use in carbon **nanofiber growth** in presence of small metal particles)

L71 ANSWER 8 OF 23 HCA COPYRIGHT 2003 ACS

127:141200 Growth of single-layer carbon tubes assisted with iron-group metal **catalysts** in carbon arc. Saito, Yahachi; Koyama, Tadao; Kawabata, Kenichiro (Dep. electrical Electronic Eng., Mie Univ., Tsu, 514, Japan). Zeitschrift fuer Physik D: Atoms, Molecules and Clusters, 40(1-4), 421-424 (English) 1997. CODEN: ZDACE2. ISSN: 0178-7683. Publisher: Springer.

AB Single-layer (SL) carbon tubes were produced by arc evapn. of graphite rods contg. iron-group metals (Fe, Co, Ni, Fe/Co, Co/Ni, Fe/Ni) under He and Ar **gas**. Transmission electron **microscopy** (TEM) revealed that these elemental and binary metals, excluding Fe which need a special atm. (a mixt. of Ar and CH4), showed **catalytic** activity producing SL tubes under pure inactive **gases**. Fe/Ni alloy was the most effectual **catalysts** for producing SL tubes. The highest abundance of SL tubes in raw soot was estd. to be .apprx. 10% from TEM observation. Smoke particles directly caught on TEM grids near an evapn. source during arc burning were also investigated, and it was suggested that small metal particles were first formed in the **gas** phase and then SL tubes grew from them.

CC 67-1 (Catalysis, Reaction Kinetics, and Inorganic Reaction Mechanisms)
Section cross-reference(s): 55, 56, 78

ST single layer carbon tube growth; iron group metal **catalyst** carbon tube

IT **Catalysts**
Nanotubes
(**growth** of **single**-layer carbon tubes assisted with iron-group metal **catalysts** in carbon arc)

IT Group VIII elements
Group VIII elements
RL: CAT (Catalyst use); USES (Uses)
(iron-group alloys; growth of single-layer carbon tubes assisted with iron-group metal **catalysts** in carbon arc)

IT Group VIII elements
Transition metal alloys
Transition metal alloys
RL: CAT (Catalyst use); USES (Uses)
(iron-group; growth of single-layer carbon tubes assisted with iron-group metal **catalysts** in carbon arc)

IT 7439-89-6, Iron, uses 7440-02-0, Nickel, uses 7440-48-4, Cobalt, uses 11102-43-5 12619-21-5 12640-13-0 12655-65-1 12783-26-5, Iron 50, nickel 50
RL: CAT (Catalyst use); USES (Uses)
(growth of single-layer carbon tubes assisted with iron-group metal **catalysts** in carbon arc)

IT 7440-44-0P, Carbon, processes
RL: PEP (Physical, engineering or chemical process); SPN (Synthetic

preparation); PREP (Preparation); PROC (Process)
(growth of single-layer carbon tubes assisted with iron-group metal **catalysts** in carbon arc)

L71 ANSWER 11 OF 23 HCA COPYRIGHT 2003 ACS
126:300939 Preparation of carbon **nanotubes** by reacting CH4 over Ni-**based catalysts**. Wang, Jun-Ke; Wang, Yu-Huang; Weng, Wei-Zheng; Zheng, Lan-Sun; Hu, Yun-Hang; Wan, Hui-Lin (Dep. Chem., Xiamen Univ., Xiamen, 361005, Peop. Rep. China). Huaxue Xuebao, 55(3), 271-276 (Chinese) 1997. CODEN: HHHPA4. ISSN: 0567-7351. Publisher: Kexue.

AB Carbon **nanotubes** were prepd. by reacting CH4 over supported Ni **catalyst** at elevated temp. The influences of support and other reaction conditions such as temp., CH4 concn. and addn. of O2 or CO2 to the reactant on the formation of carbon **nanotubes** were investigated. The formation of carbon **nanotubes** were favored when the reaction was performed at relatively low temp. with dil. CH4 as the reactant. Addn. of O2 or CO2 to the reactant is helpful for the removal of graphite and amorphous carbon deposition on the **catalyst** and therefore is favorable for the **growth** of carbon **nanotubes**.

CC 78-1 (Inorganic Chemicals and Reactions)
Section cross-reference(s): 67

ST carbon **nanotube** prepn nickel **catalyst**

IT **Nanotubes**
RL: SPN (Synthetic preparation); PREP (Preparation)
(carbon; prepn. of carbon **nanotubes** by reacting methane over nickel **catalysts**)

IT **Catalyst** supports
(effect of **catalyst** supports on prepn. of carbon **nanotubes** by reacting methane over nickel **catalysts** with added O2 or CO2)

IT 1312-81-8, Lanthanum(III) **oxide** 1344-28-1, Alumina, uses 7631-86-9, Silica, uses
RL: NUU (Other use, unclassified); USES (Uses)
(**catalyst** support for prepn. of carbon **nanotubes** by reacting methane over nickel **catalysts** with added O2 or CO2)

IT 7440-02-0, Nickel, uses
RL: CAT (Catalyst use); USES (Uses)
(prepn. of carbon **nanotubes** by reacting methane over nickel **catalysts** with added O2 or CO2)

IT 124-38-9, Carbon **dioxide**, uses 7782-44-7, Oxygen, uses
RL: NUU (Other use, unclassified); USES (Uses)
(prepn. of carbon **nanotubes** by reacting methane over nickel **catalysts** with added O2 or CO2)

IT 74-82-8, Methane, reactions
RL: RCT (Reactant); RACT (Reactant or reagent)
(prepn. of carbon **nanotubes** by reacting methane over nickel **catalysts** with added O2 or CO2)

L71 ANSWER 12 OF 23 HCA COPYRIGHT 2003 ACS
126:188001 Carbon **nanotubes grown** in situ by a novel **catalytic** method. Peigney, A.; Laurent, Ch.; Dobigeon, F.; Rousset, A. (Laboratoire de Chimie des Materiaux Inorganiques, ESA CNRS 5070, Universite Paul-Sabatier, Toulouse, 31062, Fr.). Journal of Materials Research, 12(3), 613-615 (English) 1997. CODEN: JMREEE. ISSN: 0884-2914. Publisher: Materials Research Society.

AB A novel **catalytic** method was proposed for the in-situ prodn., in a composite powder (Al1.9Fe0.1O3), of a large no. of single- and multiwalled carbon **nanotubes** by decompn. of hydrocarbons, having a diam. 1.5-15 nm and arranged in bundles up to 100 .mu.m long. The

authors anticipate that dense materials prepd. from such composite powders could have interesting mech. and phys. properties.
CC 49-1 (Industrial Inorganic Chemicals)
ST carbon **nanotube** prodn hydrocarbon **catalytic** decompn; aluminum iron **oxide catalyst** carbon **nanotube**
IT Hydrocarbons, processes
RL: PEP (Physical, engineering or chemical process); PROC (Process)
(in-situ prodn. of carbon **nanotubes** by **catalytic** decompn. of hydrocarbons in composite powder)
IT 126304-65-2, Aluminum iron **oxide** (Al1.9Fe0.1O3)
RL: CAT (Catalyst use); USES (Uses)
(in-situ prodn. of carbon **nanotubes** by **catalytic** decompn. of hydrocarbons in composite powder of)
IT 7440-44-0P, Carbon, preparation
RL: PEP (Physical, engineering or chemical process); SPN (Synthetic preparation); PREP (Preparation); PROC (Process)
(**nanotubes**; in-situ prodn. of carbon **nanotubes** by **catalytic** decompn. of hydrocarbons in composite powder)

L71 ANSWER 14 OF 23 HCA COPYRIGHT 2003 ACS
126:33892 Large-scale synthesis of aligned carbon **nanotubes**. Li, W. Z.; Xie, S. S.; Qian, L. X.; Chang, B. H.; Zou, B. S.; Zhou, W. Y.; Zhao, R. A.; Wang, G. (Inst. Physics, Chinese Academy Science, Beijing, 100080, Peop. Rep. China). Science (Washington, D. C.), 274(5293), 1701-1703 (English) 1996. CODEN: SCIEAS. ISSN: 0036-8075. Publisher: American Association for the Advancement of Science.
AB Large-scale synthesis of aligned carbon **nanotubes** was achieved by using a method **based** on chem. **vapor** deposition **catalyzed** by iron nanoparticles embedded in mesoporous silica. Scanning electron **microscope** images show that the **nanotubes** are approx. perpendicular to the **surface** of the silica and form an aligned array of isolated tubes with spacings between the tubes of about 100 nm. The tubes are up to about 50 .mu.m long and well graphitized. The growth direction of the **nanotubes** may be controlled by the pores from which the **nanotubes** **grow**.
CC 49-1 (Industrial Inorganic Chemicals)
ST carbon **nanotube** large scale synthesis
IT **Vapor** deposition process
(chem.; large-scale synthesis of aligned carbon **nanotubes**)
IT **Nanotubes**
(large-scale synthesis of aligned carbon **nanotubes**)
IT 7440-44-0P, Carbon, preparation
RL: IMF (Industrial manufacture); PREP (Preparation)
(large-scale synthesis of aligned carbon **nanotubes**)
IT 7631-86-9, Silica, uses
RL: CAT (Catalyst use); USES (Uses)
(mesoporous, Fe particles embedded in; large-scale synthesis of aligned carbon **nanotubes**)
IT 7439-89-6, Iron, uses
RL: CAT (Catalyst use); USES (Uses)
(particles; large-scale synthesis of aligned carbon **nanotubes**
)

L71 ANSWER 16 OF 23 HCA COPYRIGHT 2003 ACS
125:255050 Metallic **oxide catalyzed growth** of carbon **nanotubes**. Ohkohchi, M.; Zhao, X.; Wang, M.; Ando, Y. (Dep. of Physics, Meijo Univ., Nagoya, 468, Japan). Fullerene Science and Technology, 4(5), 977-988 (English) 1996. CODEN: FTECEG. ISSN: 1064-122X. Publisher: Dekker.

AB Carbon **nanotubes** were created in the cathode deposit by DC arc-discharge evapn. of graphite rods contg. Y2O3, La2O3 or Sc2O3. The **oxides** have **catalytic** action in promoting **growth** of the **nanotubes**. The most remarkable **catalytic** effect was obsd. for the case of metallic **oxide** addn. 2-8 wt% and arc current 165-196 A.
CC 57-8 (Ceramics)
ST yttria **catalyst** carbon **nanotube** prepn; lanthanum **oxide catalyst** carbon **nanotube** prepn; scandium **oxide catalyst** carbon **nanotube** prepn; **oxide catalyst** carbon **nanotube** prepn
IT Carbon fibers, preparation
RL: PEP (Physical, engineering or chemical process); SPN (Synthetic preparation); PREP (Preparation); PROC (Process)
(**nanotubes; catalyzed growth** of carbon **nanotubes** in the cathode deposit of arc-discharge evapn. from graphite rods contg. Y2O3, La2O3 or Sc2O3)
IT 1312-81-8, Lanthanum **oxide** (La2O3) 1314-36-9, Yttrium **oxide** (Y2O3), uses 12060-08-1, Scandium **oxide** (Sc2O3)
RL: CAT (Catalyst use); USES (Uses)
(**catalyst; catalyzed growth** of carbon **nanotubes** in the cathode deposit of arc-discharge evapn. from graphite rods contg. Y2O3, La2O3 or Sc2O3)
IT 7440-44-0P, Carbon, preparation
RL: PEP (Physical, engineering or chemical process); SPN (Synthetic preparation); PREP (Preparation); PROC (Process)
(**nanotubes; catalyzed growth** of carbon **nanotubes** in the cathode deposit of arc-discharge evapn. from graphite rods contg. Y2O3, La2O3 or Sc2O3)
IT 7782-42-5, Graphite, processes
RL: PEP (Physical, engineering or chemical process); PROC (Process)
(rods, precursor; **catalyzed growth** of carbon **nanotubes** in the cathode deposit of arc-discharge evapn. from graphite rods contg. Y2O3, La2O3 or Sc2O3)

L71 ANSWER 17 OF 23 HCA COPYRIGHT 2003 ACS
125:23135 Graphite electrodes containing nanometer-sized metal particles and their use in the synthesis of **single**-walled carbon **nanotube** composites. Cassell, Alan M.; Scrivens, Walter A.; Tour, James M. (Department of Chemistry and Biochemistry, University of South Carolina, Columbia, SC, 29208, USA). Chemistry of Materials, 8(7), 1545-1549 (English) 1996. CODEN: CMATEX. ISSN: 0897-4756. Publisher: American Chemical Society.
AB Composite graphite/metal(0) electrodes were prepd. by the absorption of org. solns. of metal carbonyls or aq. solns. of metal salts into high-purity porous graphite rods. The metal carbonyls were converted to the CO-free metal(0) species by heating the composites under an atm. of N2 and then under reduced pressure at 1000.degree.. The metal-salt-contg. graphite rods were heated under an atm. of H2 at 1000.degree. to reduce the salts to the corresponding metal(0) species. This procedure permitted dispersion of metal(0) throughout the graphite rod with av. metal particle sizes in the range 6.2-11.6 nm by TEM **microscopy** anal. Metals used were Ag, Co, Cu, Fe, La, Ni, and Pt. The composite graphite/metal(0) electrodes were **vaporized** in a plasma discharge app. under a helium atm. The Co-, Fe-, Ni, and Pt all **catalyzed single**-walled **nanotubule** (bucky tube) **growth**. The soot material from the Co, Fe, and Ni-contg. rods had a foam-rubber-like texture. All the metal-contg. soots, except for the La-derived material, could be press-molded into pellets, without the use of a binder. Data from the trace remaining ligand analyses, powder x-ray

diffraction, TEM, cond. measurements, and **surface** area analyses are presented. The properties of the arc-derived soots prepd. by this method are compared to the soots prepd. by std. cored rod/metal(0) methods.

CC 76-2 (Electric Phenomena)
Section cross-reference(s): 67, 72

ST graphite electrode carbon **nanotube** synthesis; nanometer metal particle graphite electrode; silver nm particle graphite electrode **nanotube**; cobalt nm particle graphite electrode **nanotube** ; copper nm particle graphite electrode **nanotube**; iron nm particle graphite electrode **nanotube**; lanthanum nm particle graphite electrode **nanotube**; nickel nm particle graphite electrode **nanotube**; platinum nm particle graphite electrode **nanotube**

IT Electrodes
(graphite; graphite electrodes contg. nm-sized metal particles and their use in synthesis of **single**-walled carbon **nanotube** composites)

IT 7782-42-5, Graphite, uses
RL: NUU (Other use, unclassified); USES (Uses)
(electrodes; graphite electrodes contg. nm-sized metal particles and their use in synthesis of **single**-walled carbon **nanotube** composites)

IT 7439-91-0, Lanthanum, uses
RL: NUU (Other use, unclassified); USES (Uses)
(graphite electrodes contg. nm-sized La particles and their use in synthesis of **single**-walled carbon **nanotube** composites)

IT 7440-06-4, Platinum, uses
RL: NUU (Other use, unclassified); USES (Uses)
(graphite electrodes contg. nm-sized Pt particles and their use in synthesis of **single**-walled carbon **nanotube** composites)

IT 7440-48-4, Cobalt, uses
RL: NUU (Other use, unclassified); USES (Uses)
(graphite electrodes contg. nm-sized cobalt particles and their use in synthesis of **single**-walled carbon **nanotube** composites)

IT 7440-50-8, Copper, uses
RL: NUU (Other use, unclassified); USES (Uses)
(graphite electrodes contg. nm-sized copper particles and their use in synthesis of **single**-walled carbon **nanotube** composites)

IT 7439-89-6, Iron, uses
RL: NUU (Other use, unclassified); USES (Uses)
(graphite electrodes contg. nm-sized iron particles and their use in synthesis of **single**-walled carbon **nanotube** composites)

IT 7440-02-0, Nickel, uses
RL: NUU (Other use, unclassified); USES (Uses)
(graphite electrodes contg. nm-sized nickel particles and their use in synthesis of **single**-walled carbon **nanotube** composites)

IT 7440-22-4, Silver, uses
RL: NUU (Other use, unclassified); USES (Uses)
(graphite electrodes contg. nm-sized silver particles and their use in synthesis of **single**-walled carbon **nanotube** composites)

IT 7440-44-0, Carbon, formation (nonpreparative)
RL: FMU (Formation, unclassified); FORM (Formation, nonpreparative)

(**nanotube** composites; graphite electrodes contg. nm-sized metal particles and their use in synthesis of **single**-walled carbon **nanotube** composites)

L71 ANSWER 18 OF 23 HCA COPYRIGHT 2003 ACS
123:235842 **Catalytic** Engineering of Carbon Nanostructures.
Rodriguez, Nelly M.; Chambers, Alan; Baker, R. Terry K. (Catalytic Materials Center, Pennsylvania State University, University Park, PA, 16802, USA). Langmuir, 11(10), 3862-6 (English) 1995. CODEN: LANGD5. ISSN: 0743-7463. Publisher: American Chemical Society.

AB **Catalytically grown** carbon **nanofibers** are novel materials that are the product of the decompn. of carbon-contg. **gases** over certain metal **surfaces**. The structure and properties of the fibers can be tailored by careful control of a no. of parameters including the nature of the metal **surface**, the compn. of the **gas**-phase reactant, the temp., and the incorporation of either **gas**-phase or solid additives. High-resoln. transmission electron **microscopy** studies have revealed that the **nanofibers** consist of well-ordered graphite platelet structures, the arrangement of which can be engineered to desired geometries by choice of the correct **catalyst** system. When the data from these examns. are combined with the information of the assocd. **catalyst** particle morphol., it is possible to develop models that describe many of the structural characteristics as well as some previously unknown mechanistic features of the various carbon **nanofiber** conformations.

CC 57-8 (Ceramics)

ST carbon **nanofiber** structure property **catalyst**

IT Carbon **fibers**, properties
RL: PRP (Properties)
(**nano-**; effect of **catalyst** on structures of **catalytically grown** carbon **nanofibers**)

L71 ANSWER 20 OF 23 HCA COPYRIGHT 2003 ACS
122:194899 **Catalytic growth** of carbon **nanofibers** and **nanotubes**. Baker, R. Terry K.; Rodriguez, Nelly M. (Mater. Res. Lab., The Pennsylvania State Univ., University Park, PA, 16802, USA). Materials Research Society Symposium Proceedings, 349(Novel Forms of Carbon II), 251-6 (English) 1994. CODEN: MRSPDH. ISSN: 0272-9172. Publisher: Materials Research Society.

AB Carbon **nanofibers** and **nanotubes** have been prepd. from the decompn. of carbon contg. **gases** with the aid of an iron **catalyst** particle. The phys. characteristics as well as the degree of cryst. perfection of the structures were found to be dependent on the nature of the metal particle and the conditions at which the material was grown. Transmission electron **microscopy** revealed that **nanofibers** were obtained from large **catalyst** particles (>20 nm), whereas **nanotubes** were formed by the aid of smaller particles (<20 nm). The orientation of the graphitic platelets in the carbon **nanofibers** was dependent on the alignment of the planes at the rear faces of the iron particle that were responsible for the pptn. of carbon. Carbon **nanofibers** exhibited reactivity in carbon **dioxide** comparable to that of single crystal graphite under the same conditions.

CC 57-8 (Ceramics)

ST carbon **nanofiber nanotube catalytic growth**; iron particle **catalyst** carbon **nanofiber nanotube**

IT Pipes and **Tubes**
(carbon **nano-**; properties of of carbon **nanofibers**

and **nanotubes** prepd. by decompn. of carbon contg.
gases with the aid of an iron **catalyst** particle)

IT Carbon **fibers**, preparation
RL: PEP (Physical, engineering or chemical process); PRP (Properties); SPN (Synthetic preparation); PREP (Preparation); PROC (Process)
(**nano-**; properties of of carbon **nanofibers** and **nanotubes** prepd. by decompn. of carbon contg. **gases** with the aid of an iron **catalyst** particle)

IT 7439-89-6, Iron, uses
RL: CAT (Catalyst use); USES (Uses)
(**catalyst**; properties of of carbon **nanofibers** and **nanotubes** prepd. by decompn. of carbon contg. **gases** with the aid of an iron **catalyst** particle)

IT 7440-44-0P, Carbon, preparation
RL: PEP (Physical, engineering or chemical process); PRP (Properties); SPN (Synthetic preparation); PREP (Preparation); PROC (Process)
(**nanofibers** and **nanotubes**; properties of of carbon **nanofibers** and **nanotubes** prepd. by decompn. of carbon contg. **gases** with the aid of an iron **catalyst** particle)

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L41 ANSWER 1 OF 11 HCA COPYRIGHT 2003 ACS

138:289473 Fabrication and detection method for attachment of **CNTs** to nanoprobes. Hopson, Theresa; Legge, Ron; Zhang, Ruth; Lewenstein, Justin; Nagahara, Larry (USA). IP.com Journal, 2(9), 104-105 (No. IPCOM000009248D) (English) 13 Aug 2002. IP 9248D 20020813. CODEN: IJPOBX. ISSN: 1533-0001. PRIORITY: IP 2002-9248D 20020813. Publisher: IP.com, Inc..

AB A self-monitoring method for the assembly of **C nanotube** (**CNT**) probes in a timely fashion exploits the software and piezo precision of a com. available **at. force microscope** (AFM) and eliminates problems assocd. with laborious mech. approaches. A std. metal-coated Si **cantilever** is brought into close proximity to vertically aligned CVD grown **CNT** material, and by the system's internal bias source, a voltage step is applied between the probe and **CNT** sample in two steps to attach the **CNT** to the probe. Detection of **CNT** probe attachment utilizes the built-in resonant tuning and force measurement capabilities of the AFM and thus eliminates the need for any subsequent electron beam inspection. With this technique we were able to affix **CNTs** of widely varying dimensions with remarkably high yield and robustness. We suspect that metal particles (from the growth **catalysis**) that are incorporated inside the **CNT** aid in forming a eutectic bonding weld during the voltage pulse.

CC 47-10 (Apparatus and Plant Equipment)

ST **carbon nanotube** CVD AFM tip fabrication

IT **Nanotubes**
(**carbon**; fabrication and detection method for attachment of **C nanotubes** to nanoprobes in AFM)

IT **Vapor** deposition process
(chem.; fabrication and detection method for attachment of **C nanotubes** to nanoprobes in AFM)

IT **Atomic force microscopes**
(tips; fabrication and detection method for attachment of **C nanotubes** to nanoprobes in AFM)

IT **7440-44-0, Carbon,** uses
RL: DEV (Device component use); PEP (Physical, engineering or chemical

process); PRP (Properties); PYP (Physical process); PROC (Process); USES
(Uses)
(**nanotubes**; fabrication and detection method for attachment
of **C nanotubes** to nanoprobes in AFM)

L41 ANSWER 2 OF 11 HCA COPYRIGHT 2003 ACS
138:247136 **Cantilevers** with carbon **nanotube** probes for
scanning probe microscopes (SPM) and their manufacture. Kitazawa, Masashi
(Olympus Optical Co., Ltd., Japan). Jpn. Kokai Tokkyo Koho JP 2003090788
A2 **20030328**, 9 pp. (Japanese). CODEN: JKXXAF. APPLICATION: JP
2001-284276 20010919.
AB The free ends of **cantilevers** comprise probes having .gtoreq.3
faces and the probe tip is equipped with a carbon **nanotube**
protrusion (A) which is inclined from the direction perpendicular to lever
surface or (B) along the direction extended from one of the probe faces.
Carbon **nanotubes** are grown by application of elec. voltage
between the **catalytic** metal layer formed on the
cantilever and an opposing electrode. The **cantilevers**
are equipped with probes having high aspect ratio.
IC ICM G01N013-16
ICS G12B021-08
CC 76-11 (Electric Phenomena)
ST **cantilever** carbon **nanotube** probe; scanning probe
microscope **cantilever** carbon **nanotube**
IT **Nanotubes**
(carbon; manuf. of scanning probe microscope **cantilevers** by
elec. deposition of carbon **nanotube** probes having high aspect
ratio)
IT **Cantilevers** (components)
Scanning probe microscopes
(manuf. of scanning probe microscope **cantilevers** by elec.
deposition of carbon **nanotube** probes having high aspect
ratio)
IT 7440-44-0, Carbon, uses
RL: TEM (Technical or engineered material use); USES (Uses)
(**nanotubes**; manuf. of scanning probe microscope
cantilevers by elec. deposition of carbon **nanotube**
probes having high aspect ratio)

L41 ANSWER 3 OF 11 HCA COPYRIGHT 2003 ACS
137:388078 Growth of suspended **carbon nanotube** networks on
100-nm-scale silicon pillars. Homma, Yoshikazu; Kobayashi, Yoshihiro;
Ogino, Toshio; Yamashita, Takayuki (NTT Basic Research Laboratories,
Nippon Telegraph and Telephone Corporation, Atsugi, Kanagawa, 243-0198,
Japan). Applied Physics Letters, 81(12), 2261-2263 (English) **2002**
. CODEN: APPLAB. ISSN: 0003-6951. Publisher: American Institute of
Physics.
AB **Carbon nanotube** growth by methane CVD on ultrafine
silicon patterns prepd. by synchrotron-radiation lithog. was investigated.
Grown **nanotubes** formed suspended bridges between pillars when
pillar spacing was comparable to pillar height. Network-like
interconnections were obtained on pillar arrays. Nearest-neighbor
bridging accounted for > 80% of all the bridging **nanotubes**. The
self-directed growth between neighboring pillars may be explained by the
swing of the **nanotube cantilever** which contacts a
catalyst particle in liq. phase as the **nanotube** grows.
These results confirm the possibility of self-assembled wiring of
nanostructures.
CC 57-8 (Ceramics)
Section cross-reference(s): 66

ST **carbon nanotube** network CVD silicon nanostructure
IT **Nanotubes**
(**carbon**; growth of suspended **carbon nanotube** networks on 100-nm-scale silicon pillars)
IT **Vapor** deposition process
(chem.; growth of suspended **carbon nanotube** networks on 100-nm-scale silicon pillars)
IT Nanostructures
(growth of suspended **carbon nanotube** networks on 100-nm-scale silicon pillars)
IT Microstructure
(of suspended **carbon nanotube** networks grown on 100-nm-scale silicon pillars)
IT 7440-21-3, Silicon, uses
RL: NUU (Other use, unclassified); USES (Uses)
(growth of suspended **carbon nanotube** networks on 100-nm-scale silicon pillars)
IT 74-82-8, Methane, processes
RL: CPS (Chemical process); PEP (Physical, engineering or chemical process); PROC (Process)
(growth of suspended **carbon nanotube** networks on 100-nm-scale silicon pillars by CVD of)
IT **7440-44-0, Carbon**, properties
RL: FMU (Formation, unclassified); PRP (Properties); FORM (Formation, nonpreparative)
(**nanotubes**; growth of suspended **carbon nanotube** networks on 100-nm-scale silicon pillars)

L41 ANSWER 4 OF 11 HCA COPYRIGHT 2003 ACS
137:286685 Growth of **carbon nanotubes** by thermal and plasma chemical **vapour** deposition processes and applications in microscopy. Delzeit, Lance; Nguyen, Cattien V.; Stevens, Ramsey M.; Han, Jie; Meyyappan, M. (NASA Ames Research Center, Moffett Field, CA, 94035, USA). Nanotechnology, 13(3), 280-284 (English) **2002**. CODEN: NNOTER. ISSN: 0957-4484. Publisher: Institute of Physics Publishing.
AB **Single**-walled **C nanotubes** (**SWNTs**) are grown from a CH4 feedstock by thermal CVD. An C2H4-H2 plasma generated in an inductively coupled plasma reactor primarily yields multi-walled **C nanotubes** and thicker fibers. In both cases, an iron **catalyst** layer and an aluminum **underlayer** are deposited by ion beam sputtering onto silicon wafers for the growth of **C nanotubes** (**CNTs**). The plasma process provides well-aligned multi-walled **nanofibres** useful for fabrication of electrodes and sensors and further tip functionalization whereas thermal CVD produces a mat of **SWNT** ropes. In addn., **CNTs** grown at the tips of Si **cantilevers** are demonstrated to be ideal for high-resoln. imaging of biol. samples and simulated Mars dust grains using AFM.
CC 75-1 (Crystallography and Liquid Crystals)
ST **carbon nanotube** thermal plasma CVD
IT **Nanotubes**
(**carbon**; growth of **carbon nanotubes** by thermal and plasma CVD processes and applications in microscopy)
IT **Vapor** deposition process
(chem., thermal; growth of **carbon nanotubes** by thermal and plasma CVD processes and applications in microscopy)
IT Microstructure
(growth of **carbon nanotubes** by thermal and plasma CVD processes and applications in microscopy)
IT **Vapor** deposition process

(plasma; growth of **carbon nanotubes** by thermal and
plasma CVD processes and applications in microscopy)
IT **7440-44-0, Carbon,** properties
RL: PEP (Physical, engineering or chemical process); PRP (Properties); PYP
(Physical process); PROC (Process)
(**nanotubes;** growth of **carbon nanotubes** by
thermal and plasma CVD processes and applications in microscopy)

L41 ANSWER 5 OF 11 HCA COPYRIGHT 2003 ACS
137:27118 **Carbon nanotubes** and methods of fabrication
thereof using a liquid phase **catalyst** precursor. Dai, Hongjie;
Quate, Calvin F.; Chen, Robert J. (The Board of Trustees of the Leland
Stanford Junior University, USA). U.S. US 6401526 B1 **20020611,**
12 pp. (English). CODEN: USXXAM. APPLICATION: US 1999-467096 19991210.
AB The invention relates to a process for making a **single**-walled
carbon nanotube (**SWNT**), suited for use in
probe-tips for **at. force microscopy** (AFM),
realized by direct synthesis of **SWNT** on silicon pyramids
integrated onto AFM **cantilevers**. The growth of **SWNT**
tips involves dip coating of silicon pyramids with a liq. phase
catalyst followed by chem. **vapor** deposition (CVD) using
methane. Van der Waals interactions between the silicon pyramidal
surface and the **nanotube** ensure proper **SWNT**
orientation. Prodn. of large scale arrays of **nanotube** probe
tips using contact printing and controllably shortening **nanotubes**
in an inert discharge are also described.
IC ICM G01B005-028
ICS D01C005-00; D01F009-12
NCL 073105000
CC 76-14 (Electric Phenomena)
ST **single** walled **carbon nanotube** probe
atomic force microscope
IT **Nanotubes**
(**carbon, SWNT;** manuf. of **single**-walled
carbon nanotube (**SWNT**) for probe-tip of
at. force microscope (AFM))
IT **Vapor** deposition process
(chem.; manuf. of **single**-walled **carbon**
nanotube (**SWNT**) for probe-tip of **at.**
force microscope (AFM))
IT **Atomic force microscopy**
(probe; manuf. of **single**-walled **carbon**
nanotube (**SWNT**) for probe-tip of **at.**
force microscope (AFM))
IT 7440-21-3, Silicon, processes
RL: DEV (Device component use); EPR (Engineering process); PEP (Physical,
engineering or chemical process); PROC (Process); USES (Uses)
(manuf. of **single**-walled **carbon nanotube**
(**SWNT**) for probe-tip of **at. force**
microscope (AFM))

L41 ANSWER 6 OF 11 HCA COPYRIGHT 2003 ACS
136:407218 Wafer scale production of **carbon nanotube**
scanning probe tips for **atomic force**
microscopy. Yenilmez, Erhan; Wang, Qian; Chen, Robert J.; Wang,
Dunwei; Dai, Hongjie (Department of Chemistry, Stanford University,
Stanford, CA, 94305, USA). Applied Physics Letters, 80(12), 2225-2227
(English) **2002**. CODEN: APPLAB. ISSN: 0003-6951. Publisher:
American Institute of Physics.
AB A methodol. is developed to enable wafer scale fabrication of

single-walled **carbon nanotube** (**SWNT**)
tips for **at. force microscopy**.
Catalyst selectively placed onto 375 prefabricated Si tips on a wafer is made possible by a simple patterning technique. Chem. **vapor** deposition on the wafer scale leads to the growth of **SWNTs** protruding from more than 90% of the Si tips. This represents an important step towards the scale up of **nanotube** probe tips for advanced nanoscale imaging of solid-state and soft biol. systems and for scanning probe lithog.

CC 66-3 (Surface Chemistry and Colloids)

ST **carbon nanotube** tip silicon **cantilever** **atomic force microscopy**

IT **Nanotubes**
(**carbon**; wafer scale prodn. of **carbon nanotube** scanning probe tips for **at. force microscopy**)

IT **Vapor** deposition process
(chem.; wafer scale prodn. of **carbon nanotube** scanning probe tips for **at. force microscopy**)

IT **Atomic force microscopes**
(tips; wafer scale prodn. of **carbon nanotube** scanning probe tips for **at. force microscopy**)

IT **Cantilevers** (components)
Catalysts
(wafer scale prodn. of **carbon nanotube** scanning probe tips for **at. force microscopy**)

IT 7440-21-3, Silicon, uses
RL: DEV (Device component use); USES (Uses)
(**cantilevers**; wafer scale prodn. of **carbon nanotube** scanning probe tips for **at. force microscopy**)

IT 9011-14-7, PMMA
RL: NUU (Other use, unclassified); USES (Uses)
(coating; wafer scale prodn. of **carbon nanotube** scanning probe tips for **at. force microscopy**)

IT 1344-28-1, Alumina, uses
RL: CAT (Catalyst use); USES (Uses)
(nanoparticles, suspension; wafer scale prodn. of **carbon nanotube** scanning probe tips for **at. force microscopy**)

IT **7440-44-0, Carbon**, uses
RL: DEV (Device component use); USES (Uses)
(**nanotubes**; wafer scale prodn. of **carbon nanotube** scanning probe tips for **at. force microscopy**)

IT 10421-48-4 17524-05-9
RL: CAT (Catalyst use); USES (Uses)
(wafer scale prodn. of **carbon nanotube** scanning probe tips for **at. force microscopy**)

IT 74-82-8, Methane, reactions
RL: RCT (Reactant); RACT (Reactant or reagent)
(wafer scale prodn. of **carbon nanotube** scanning probe tips for **at. force microscopy**)

L41 ANSWER 7 OF 11 HCA COPYRIGHT 2003 ACS
136:373437 **Electric**-field-enhanced growth of **carbon nanotubes** for scanning probe microscopy. Ono, Takahito;

Miyashita, Hidetoshi; Esashi, Masayoshi (Department of Mechatronics and Precision Engineering, Graduate School of Engineering, Tohoku University, Sendai, 980-8579, Japan). Nanotechnology, 13(1), 62-64 (English) **2002**. CODEN: NNOTER. ISSN: 0957-4484. Publisher: Institute of Physics Publishing.

AB The influence of an **elec**. field on **carbon nanotube** (**CNT**) growth using hot-filament chem. **vapor** deposition is investigated. Acetylene (C2H2) **gas** dild. with hydrogen is used as the source **gas** for the growth of **CNTs**, and a bias voltage of -300 V is applied to the sample stage during growth. The silicon **substrate** onto which the **CNT** is grown is prepd. by sputtering a thin **catalyzed** metal (Ni) film onto the **surface**, and the **CNT** is selectively grown from the tip of a silicon protrusion on the **substrate**. It is found that the application of a high electrostatic field with a neg. **substrate** bias enhances the growth of **CNTs** in this situation. This effect is successfully applied to the fabrication of a **CNT** tip supported by a silicon **cantilever** for use in scanning probe microscopy.

CC 57-8 (Ceramics)

ST **elec** field CVD **carbon nanotube** scanning probe microscopy; silicon **cantilever carbon nanotube** CVD **elec** field **substrate** bias

IT **Nanotubes**
(**carbon; elec**.-field-enhanced growth of **carbon nanotubes** for scanning probe microscopy)

IT **Vapor** deposition process
(chem., hot-filament; **elec**.-field-enhanced growth of **carbon nanotubes** for scanning probe microscopy)

IT **Electric** field effects
Scanning probe microscopy
(**elec**.-field-enhanced growth of **carbon nanotubes** for scanning probe microscopy)

IT **Cantilevers** (components)
(silicon; **elec**.-field-enhanced growth of **carbon nanotubes** for scanning probe microscopy)

IT Bias potential
(**substrate; elec**.-field-enhanced growth of **carbon nanotubes** for scanning probe microscopy)

IT 74-86-2, Ethyne, processes
RL: CPS (Chemical process); PEP (Physical, engineering or chemical process); PROC (Process)
(precursor; **elec**.-field-enhanced growth of **carbon nanotubes** for scanning probe microscopy)

L41 ANSWER 8 OF 11 HCA COPYRIGHT 2003 ACS

136:316233 **Catalyst**-induced growth of **carbon nanotubes** on tips of **cantilevers** and nanowires. Lee, James Weifu; Lowndes, Douglas H.; Merkulov, Vladimir I.; Eres, Gyula; Wei, Yayi; Greenbaum, Elias; Lee, Ida (USA). U.S. Pat. Appl. Publ. US 2002046953 A1 **20020425**, 17 pp., Cont.-in-part of U. S. Ser. No. 694,978. (English). CODEN: USXXCO. APPLICATION: US 2001-873928 20010604. PRIORITY: US 2000-694978 20001024.

AB A method is described for **catalyst**-induced growth of **carbon nanotubes, nanofibers**, and other nanostructures on the tips of nanowires, **cantilevers**, conductive micro/nm structures, wafers and the like. The method can be used for prodn. of **carbon nanotube**-anchored **cantilevers** that can significantly improve the performance of scanning probe microscopy (AFM, EFM etc). The invention can also be used in many other

processes of micro and/or nanofabrication with **carbon** **nanotubes**/fibers. Key elements of this invention include: (1) Proper selection of a metal **catalyst** and programmable pulsed electrolytic deposition of the desired specific **catalyst** precisely at the tip of a **substrate**, (2) **Catalyst** -induced growth of **carbon nanotubes**/fibers at the **catalyst**-deposited tips, (3) Control of **carbon** **nanotube**/fiber growth pattern by manipulation of tip shape and growth conditions, and (4) Automation for mass prodn.

IC ICM C25D005-18
ICS C25D007-12; B32B009-04

NCL 205104000

CC 72-8 (Electrochemistry)
Section cross-reference(s): 56, 67

ST **carbon nanotubes catalyst** induced growth **cantilevers** nanowires tips; plasma chem **vapor** deposition **carbon nanotubes catalyst** induced; metal **catalyst** electrodeposition **carbon nanotubes** plasma growth **cantilevers** nanowires

IT **Nanotubes**
(**carbon**; **catalyst**-induced growth of **carbon** **nanotubes** on tips of **cantilevers** and nanowires)

IT **Cantilevers** (components)
Nanowires
(**catalyst**-induced growth of **carbon** **nanotubes** on tips of **cantilevers** and nanowires)

IT Microelectronic devices
Nanostructures
(**catalyst**-induced growth of **carbon** **nanotubes**, nanowires and other nanostructures on tips of **cantilevers** and nanowires)

IT Metals, uses
RL: CAT (Catalyst use); CPS (Chemical process); PEP (Physical, engineering or chemical process); PNU (Preparation, unclassified); PREP (Preparation); PROC (Process); USES (Uses)
(**catalyst**-induced growth of **carbon** **nanotubes**, nanowires and other nanostructures on tips of **cantilevers** and nanowires using pulsed electrodeposition of desired specific **catalyst**)

IT **Catalysts**
(metal; **catalyst**-induced growth of **carbon** **nanotubes**, nanowires and other nanostructures on tips of **cantilevers** and nanowires)

IT Process automation
(of **catalyst**-induced growth of **carbon** **nanotubes**, nanowires and other nanostructures on tips of **cantilevers** and nanowires using pulsed electrodeposition of desired specific **catalyst**)

IT **Vapor** deposition process
(plasma; **catalyst**-induced growth of **carbon** **nanotubes**, nanowires and other nanostructures on tips of **cantilevers** and nanowires using pulsed electrodeposition of desired specific **catalyst** and)

IT Electrodeposition
(pulse; **catalyst**-induced growth of **carbon** **nanotubes**, nanowires and other nanostructures on tips of **cantilevers** and nanowires using pulsed electrodeposition of desired specific **catalyst**)

IT 7440-02-0P, Nickel, uses
RL: CAT (Catalyst use); CPS (Chemical process); PEP (Physical, engineering

or chemical process); PNU (Preparation, unclassified); PREP (Preparation); PROC (Process); USES (Uses)
(**catalyst**-induced growth of **carbon nanotubes**, nanowires and other nanostructures on tips of **cantilevers** and nanowires using pulsed electrodeposition of desired specific **catalyst**)

IT 7440-21-3, Silicon, uses 12033-89-5, Silicon nitride (Si3N4), uses
RL: DEV (Device component use); MSC (Miscellaneous); USES (Uses)
(**catalyst**-induced growth of **carbon nanotubes**, nanowires and other nanostructures on tips of **cantilevers** and nanowires using pulsed electrodeposition of desired specific **catalyst** nickel on Si **substrate** with Ti buffer layer)

IT 7440-32-6, Titanium, uses
RL: NUU (Other use, unclassified); USES (Uses)
(**catalyst**-induced growth of **carbon nanotubes**, nanowires and other nanostructures on tips of **cantilevers** and nanowires using pulsed electrodeposition of desired specific **catalyst** nickel on Si **substrate** with Ti buffer layer)

IT **7440-44-0P, Carbon,** processes
RL: CPS (Chemical process); PEP (Physical, engineering or chemical process); PNU (Preparation, unclassified); PREP (Preparation); PROC (Process)
(**nanotubes; catalyst**-induced growth of **carbon nanotubes** on tips of **cantilevers** and nanowires)

L41 ANSWER 9 OF 11 HCA COPYRIGHT 2003 ACS

136:89298 **Carbon nanotubes** by CVD and applications.
Cassell, A.; Delzeit, L.; Nguyen, C.; Stevens, R.; Han, J.; Meyyappan, M. (NASA Ames Research Center, Moffett Field, CA, 94035, USA). Journal de Physique IV: Proceedings, 11(Pr3, Thirteenth European Conference on Chemical Vapor Deposition, 2001), Pr3/401-Pr3/409 (English) **2001**
. CODEN: JPICEI. ISSN: 1155-4339. Publisher: EDP Sciences.

AB A review. **Carbon nanotube** (**CNT**) exhibits extraordinary mech. and unique electronic properties and offers significant potential for structural, sensor, and nanoelectronics applications. An overview of **CNT**, growth methods, properties and applications is provided. Single-wall, and multi-wall **CNTs** have been grown by chem. **vapor** deposition. **Catalyst** development and optimization has been accomplished using combinatorial optimization methods. **CNT** has also been grown from the tips of silicon **cantilevers** for use in **at. force microscopy**.

CC 57-0 (Ceramics)

ST review **carbon nanotube** CVD application

IT **Vapor** deposition process
(CVD and applications of **carbon nanotubes**)

IT **Nanotubes**
RL: TEM (Technical or engineered material use); USES (Uses)
(**carbon**; CVD and applications of **carbon nanotubes**)

IT **7440-44-0, Carbon,** uses
RL: TEM (Technical or engineered material use); USES (Uses)
(**nanotubes**; CVD and applications of **carbon nanotubes**)

L41 ANSWER 10 OF 11 HCA COPYRIGHT 2003 ACS

134:201658 Strongly textured atomic ridges and dots in a MOSFET device.

Kendall, Don; Guttag, Mark (Starmega Corporation, USA). PCT Int. Appl. WO 2001018866 A1 **20010315**, 69 pp. DESIGNATED STATES: W: AE, AG, AL, AM, AT, AU, AZ, BA, BB, BG, BR, BY, BZ, CA, CH, CN, CR, CU, CZ, DE, DK, DM, DZ, EE, ES, FI, GB, GD, GE, GH, GM, HR, HU, ID, IL, IN, IS, JP, KE, KG, KP, KR, KZ, LC, LK, LR, LS, LT, LU, LV, MA, MD, MG, MK, MN, MW, MX, MZ, NO, NZ, PL, PT, RO, RU, SD, SE, SG, SI, SK, SL, TJ, TM, TR, TT, TZ, UA, UG, UZ, VN, YU, ZA, ZW, AM, AZ, BY, KG, KZ, MD, RU, TJ, TM; RW: AT, BE, BF, BJ, CF, CG, CH, CI, CM, CY, DE, DK, ES, FI, FR, GA, GB, GR, IE, IT, LU, MC, ML, MR, NE, NL, PT, SE, SN, TD, TG. (English). CODEN: PIXXD2. APPLICATION: WO 2000-US24815 20000908. PRIORITY: US 1999-PV153088 19990910.

AB The present invention provides a MOSFET device comprising: a **substrate** including a plurality of at. ridges, each of the at. ridges including a semiconductor layer comprising Si and a dielec. layer comprising a Si compd.; a plurality nanogrooves between the at. ridges; .gtoreq.1 elongated mol. located in .gtoreq.1 of the nanogrooves; a porous gate layer located on top of the plurality of at. ridges. The present invention also provides a membrane comprising: a **substrate**; and a plurality of nanowindows in the **substrate** and a method for forming nanowindows in a **substrate**. The present invention also provides a multi-tip array device comprising: a **substrate**; a multi-tip array of at. tips on the **substrate**, the multi-tip array having a pitch of 0.94-5.4 nm between adjacent tips in .gtoreq.1 direction; and means for moving the **substrate**. The present invention also provides an at. claw comprising: a mounting block; a paddle having a multi-tip array thereon, the multi-tip array having a pitch of 0.94-5.4 nm between adjacent tips in .gtoreq.1 direction; and a **cantilever** connected to the paddle and the mounting block, in which the **cantilever** allows the paddle to be moved in .gtoreq.1 arcuate direction.

IC ICM H01L027-14

CC 76-3 (Electric Phenomena)
Section cross-reference(s): 75

IT **Nanotubes**
RL: DEV (Device component use); USES (Uses)
(**carbon**, elongated mol.; strongly textured at. ridges and dots in a nanostructured MOSFET device)

IT Membranes, nonbiological
(silicon **substrate**; strongly textured at. ridges and dots in a nanostructured MOSFET device)

IT **Cantilevers** (components)
Integrated circuits
Molecular beam epitaxy
Nanostructures
Photomasks (lithographic masks)
Sensors
(strongly textured at. ridges and dots in a nanostructured MOSFET device)

IT Group IIIA element compounds
RL: NUU (Other use, unclassified); USES (Uses)
(**substrate**; strongly textured at. ridges and dots in a nanostructured MOSFET device)

IT 1333-74-0, Hydrogen, uses 1590-87-0, Disilane 7440-37-1, Argon, uses 7782-50-5, Chlorine, uses
RL: NUU (Other use, unclassified); USES (Uses)
(active etching **gas**; strongly textured at. ridges and dots in a nanostructured MOSFET device)

IT 7440-06-4, Platinum, uses
RL: CAT (Catalyst use); USES (Uses)
(**catalyst**; strongly textured at. ridges and dots in a

nanostructured MOSFET device)
IT 7664-41-7, Ammonia, analysis 10102-44-0, Nitrogen **oxide** (NO_2), analysis
RL: ANT (Analyte); ANST (Analytical study)
(detection by **nanotubes**; strongly textured at. ridges and dots in a nanostructured MOSFET device)
IT 7440-21-3, Silicon, uses
RL: DEV (Device component use); USES (Uses)
(semiconductor layer, **substrate**; strongly textured at. ridges and dots in a nanostructured MOSFET device)
IT 7440-56-4, Germanium, uses 7782-40-3, Diamond, uses
RL: NUU (Other use, unclassified); USES (Uses)
(**substrate**; strongly textured at. ridges and dots in a nanostructured MOSFET device)

L41 ANSWER 11 OF 11 HCA COPYRIGHT 2003 ACS
132:168101 **Carbon nanotube** structures made using **catalyst** islands. Dai, Hongjie; Quate, Calvin F.; Soh, Hyongsok; Kong, Jing (The Board of Trustees of the Leland Stanford Junior University, USA). PCT Int. Appl. WO 2000009443 A1 20000224, 26 pp. DESIGNATED STATES: W: CA, JP; RW: AT, BE, CH, CY, DE, DK, ES, FI, FR, GB, GR, IE, IT, LU, MC, NL, PT, SE. (English). CODEN: PIXXD2. APPLICATION: WO 1999-US15222 19990702. PRIORITY: US 1998-133948 19980814.
AB **Multiple nanotubes** are made using **catalyst** islands disposed on a **substrate** (e.g. Si, Al_2O_3 or quartz) or on the free end of an **at. force microscope** (AFM) **cantilever**. The **catalyst** islands can **catalyze** the growth of **carbon nanotubes** from **carbon** contg. **gases** (e.g., methane). An island of **catalyst** material (e.g., Fe_2O_3) is provided on the **substrate** with a **carbon nanotube** extending from the island. Also a pair of islands is provided with a **nanotube** extending between the islands, **elec**. connecting them. Conductive metal lines connected to the islands (which may be a few microns on a side) allows for external circuitry to connect to the **nanotube**. Such a structure can be used in many different electronic and microelectromech. devices. Also, the present invention includes a **catalyst** particle disposed on the free end of an AFM **cantilever** and having a **nanotube** extending from the particle. The **nanotube** can be used as the scanning tip of the AFM.
IC ICM C01B031-00
ICS G01B007-34
CC 47-8 (Apparatus and Plant Equipment)
Section cross-reference(s): 57, 67, 73, 76
ST **carbon nanotube** structure formation **catalyst** island; **atomic force microscope** scanning tip **carbon nanotube**
IT **Atomic force microscopes**
(**carbon nanotube** structures made using **catalyst** islands for AFM tips)
IT Hydrocarbons, processes
RL: PEP (Physical, engineering or chemical process); RCT (Reactant); PROC (Process); RACT (Reactant or reagent)
(**carbon nanotube** structures made using **catalyst** islands for AFM tips)
IT **Nanotubes**
RL: DEV (Device component use); SPN (Synthetic preparation); TEM (Technical or engineered material use); PREP (Preparation); USES (Uses)
(**carbon**; **carbon nanotube** structures made

using **catalyst** islands for AFM tips)
IT 1309-37-1, Iron **oxide** (Fe2O3), uses 1313-27-5, Molybdenum **oxide**, uses 1313-99-1, Nickel **oxide**, uses 1314-13-2, Zinc **oxide**, uses 7439-89-6, Iron, uses 7439-98-7, Molybdenum, uses 7440-02-0, Nickel, uses 7440-18-8, Ruthenium, uses 7440-48-4, Cobalt, uses 7440-66-6, Zinc, uses 11104-61-3, Cobalt **oxide** 11113-84-1, Ruthenium **oxide**
RL: CAT (Catalyst use); USES (Uses)
(**carbon nanotube** structures made using **catalyst** islands for AFM tips)
IT 1344-28-1, Alumina, uses 7440-21-3, Silicon, uses 12033-89-5, Silicon nitride, uses 14808-60-7, Quartz, uses
RL: DEV (Device component use); TEM (Technical or engineered material use); USES (Uses)
(**carbon nanotube** structures made using **catalyst** islands for AFM tips)
IT 7720-78-7, Ferrous sulfate 10421-48-4, Ferric nitrate
RL: NUU (Other use, unclassified); PEP (Physical, engineering or chemical process); PROC (Process); USES (Uses)
(**carbon nanotube** structures made using **catalyst** islands for AFM tips)
IT 74-82-8, Methane, processes
RL: PEP (Physical, engineering or chemical process); RCT (Reactant); PROC (Process); RACT (Reactant or reagent)
(**carbon nanotube** structures made using **catalyst** islands for AFM tips)

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FILE 'COMPENDEX' ENTERED AT 11:25:31 ON 16 MAY 2003

FILE 'INSPEC' ENTERED AT 11:25:31 ON 16 MAY 2003

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L102 ANSWER 1 OF 1 INSPEC COPYRIGHT 2003 FIZ KARLSRUHE
AN 2000:6680996 INSPEC DN A2000-19-0777-001; B2000-10-7410B-012
TI Fullerene **nanotubes** as transporting and focusing elements of nanoscale beam technology.
AU Dedkov, G.V.; Karamurzov, B.S. (Kabardino-Balkarian State Univ., Nalchik, Russia)
SO Surface and Coatings Technology (June-July 2000) vol.128-129, p.51-8. 17 refs.
Doc. No.: S0257-8972(00)00656-3
Published by: Elsevier
Price: CCCC 0257-8972/2000/$20.00
CODEN: SCTEEJ ISSN: 0257-8972
SICI: 0257-8972(200006/07)128/129L.51:FNTF;1-N
Conference: Eleventh International Conference on Surface Modifications of Metals by Ion Beams. Beijing, China, 19-24 Sept 1999
DT Conference Article; Journal
TC Experimental
CY Switzerland

LA English
AB The **nanotubes** with a diameter of 1-100 nm and length of 1 mm are shown to be effective tools in future developments related to microelectronics and nanoscale beam technology. Straight and bended **nanotubes** allow the transporting and deflecting of neutral and charged particle beams with great efficiency. Combined with the **cantilever** of the atomic-force microscope, **nanotubes** make it possible to carry out the surface modification omitting standard technological stages accepted in microelectronics. Also, it is possible to get hard electromagnetic radiation by relativistic electrons and positrons, accepted in bound states of the transverse energy spectrum. The radiation cooling of the **nanotubes** heated by particle beams proved to stabilize their temperature at approximately 200-300 K.
CC A0777 Particle beam production and handling; targets; A4180 Particle beams and particle optics; A2925F Beam handling, focusing, pulsing, stripping and diagnostics; A6148 Structure of fullerenes and fullerene-related materials; A6180M Channelling, blocking and energy loss of particles; B7410B Particle beam handling and diagnostics; B2230F Fullerene, nanotube and related devices
CT ATOMIC FORCE MICROSCOPY; CARBON **NANOTUBES**; COOLING; ENERGY LOSS OF PARTICLES; FULLERENE DEVICES; FULLERENES; **LITHOGRAPHY**; NANOTECHNOLOGY; PARTICLE BEAM FOCUSING
ST **fullerene nanotubes**; nanoscale beam technology; transporting elements; focusing elements; **nanotubes size**; microelectronics; **straight nanotubes**; **bended nanotubes**; neutral particle beams; charged particle beams; beam deflection; atomic-force microscope; **cantilever**; surface modification; hard electromagnetic radiation; relativistic electrons; relativistic positrons; electron-positron bound states; transverse energy spectrum; radiation cooling; particle beams heating; temperature stabilisation; 1 to 100 nm; 200 to 300 K; C60
CHI C60 el, C el
PHP size 1.0E-09 to 1.0E-07 m; temperature 2.0E+02 to 3.0E+02 K
ET C

=> d L100 1-15 ti

L100 ANSWER 1 OF 15 COMPENDEX COPYRIGHT 2003 EEI
TI Atomic force microscopy of nickel dot arrays with tuning fork and **nanotube** probe.

L100 ANSWER 2 OF 15 COMPENDEX COPYRIGHT 2003 EEI
TI Metrology, inspection, and process control for **microlithography** XVI.

L100 ANSWER 3 OF 15 COMPENDEX COPYRIGHT 2003 EEI
TI Micro-nanosystems by bulk silicon micromachining.

L100 ANSWER 4 OF 15 COMPENDEX COPYRIGHT 2003 EEI
TI Growth of carbon **nanotubes** by thermal and plasma chemical vapour deposition processes and applications in **microscopy**.

L100 ANSWER 5 OF 15 COMPENDEX COPYRIGHT 2003 EEI
TI Electric-field-enhanced growth of carbon **nanotubes** for scanning probe **microscopy**.

L100 ANSWER 6 OF 15 COMPENDEX COPYRIGHT 2003 EEI
TI Nanotechnology: Science and technology of nonostructures.

L100 ANSWER 7 OF 15 COMPENDEX COPYRIGHT 2003 EEI

□□FILE 'HCA' ENTERED AT

=> d L71 9,19 cbib abs hitind

L71 ANSWER 9 OF 23 HCA COPYRIGHT 2003 ACS
127:112245 Well-aligned graphitic **nanofibers** synthesized by plasma-assisted chemical **vapor** deposition. Chen, Yan; Wang, Zhong Lin; Yin, Jin Song; Johnson, David J.; Prince, R. H. (Department of Physics and Astronomy, York University, North York, Ont., Can.). Chemical Physics Letters, 272(3,4), 178-182 (English) 1997. CODEN: CHPLBC. ISSN: 0009-2614. Publisher: Elsevier.

AB Well-aligned graphitic **nanofibers** on a large scale have been grown on Ni(100) wafers by plasma-assisted hot filament chem. **vapor** deposition using a mixed **gas** of nitrogen and methane. A two-stage control of the plasma intensity has been used in the nucleation and growth stages of the fibers. The growth direction of the fibers is perpendicular to the **substrate surface** and the plasma-induced Ni particles serve as a **catalyst**. The diam. of the fibers is in the range 50-500 nm, mostly between 100-200 nm, controlled by the size of the nickel particles. The growth mechanism of the fibers is described **based** on structural information provided by SEM and transmission electron **microscopy**.

CC 57-8 (Ceramics)
Section cross-reference(s): 78

ST carbon **nanofiber growth** plasma assisted CVD

IT **Nanotubes**
RL: PEP (Physical, engineering or chemical process); PRP (Properties); SPN (Synthetic preparation); PREP (Preparation); PROC (Process)
(carbon; **growth** of well-aligned graphitic **nanofibers** by plasma-assisted hot-filament CVD on Ni(100) wafers using nitrogen-methane mixed **gas**)

IT **Vapor** deposition process
(chem.; growth of well-aligned graphitic **nanofibers** by plasma-assisted hot-filament CVD on Ni(100) wafers using nitrogen-methane mixed **gas**)

IT 74-82-8, Methane, processes
RL: PEP (Physical, engineering or chemical process); PROC (Process)
(carbon **gas**; growth of well-aligned graphitic **nanofibers** by plasma-assisted hot-filament CVD on Ni(100) wafers using nitrogen-methane mixed **gas**)

IT 7440-44-0P, Carbon, preparation 7782-42-5P, Graphite, preparation
RL: PEP (Physical, engineering or chemical process); PRP (Properties); SPN (Synthetic preparation); PREP (Preparation); PROC (Process)
(**nanofibers**; **growth** of well-aligned graphitic **nanofibers** by plasma-assisted hot-filament CVD on Ni(100) wafers using nitrogen-methane mixed **gas**)

IT 7440-44-0P, Carbon, preparation 7782-42-5P, Graphite, preparation
RL: PEP (Physical, engineering or chemical process); PRP (Properties); SPN (Synthetic preparation); PREP (Preparation); PROC (Process)
(**nanofibers**; **growth** of well-aligned graphitic **nanofibers** by plasma-assisted hot-filament CVD on Ni(100) wafers using nitrogen-methane mixed **gas**)

L71 ANSWER 19 OF 23 HCA COPYRIGHT 2003 ACS
123:120847 Pyrolytic carbon **nanotubes** from **vapor-grown** carbon fibers. Endo, Morinobu; Takeuchi, Kenji; Kobori, Kiyoharu; Takahashi, Katsushi; Kroto, Harold W.; Sarkar, A. (Fac. Eng.,

Shinshu Univ., Nagano, 380, Japan). Carbon, 33(7), 873-81 (English) 1995.
CODEN: CRBNAH. ISSN: 0008-6223. Publisher: Elsevier.

AB The structure of as-grown and heat-treated pyrolytic carbon **nanotubes** (PCNTs) produced by hydrocarbon pyrolysis are discussed on the basis of a possible growth process. The structures are compared with those of **nanotubes** obtained by the arc method (ACNT; arc-formed carbon **nanotubes**). PCNTs, with and without secondary pyrolytic deposition (which results in diam. increase) are found to form during pyrolysis of benzene at temps. ca. 1060.degree.C under hydrogen. PCNTs after heat treatment at above 2800.degree.C under argon exhibit have improved stability and can be studied by high-resoln. transmission electron **microscopy** (HRTEM). The microstructures of PCNTs closely resemble those of **vapor**-grown carbon fibers (VGCFs). Some VGCFs that have micro-sized diams. appear to have **nanotube** inner cross-sections that have different mech. properties from those of the outer pyrolytic sections. PCNTs initially appear to grow as ultra-thin graphene tubes with central hollow cores (diam. ca. 2 nm or more) and **catalytic** particles are not obsd. at the tip of these tubes. The secondary pyrolytic deposition, which results in characteristic thickening by addn. of extra cylindrical carbon layers, appears to occur simultaneously with **nanotube** lengthening **growth**. After heat treatment, HRTEM studies indicate clearly that the hollow cores are closed at the ends of polygonized hemi-spherical carbon caps. The most commonly obsd. cone angle at the tip is generally ca. 20.degree., which implies the presence of five pentagonal disclinations clustered near the tip of the hexagonal network. A structural model is proposed for PCNTs obsd. to have spindle-like shape and conical caps at both ends. Evidence is presented for the formation, during heat treatment, of hemi-toroidal rims linking adjacent concentric walls in PCNTs. A possible growth mechanism for PCNTs, in which the tip of the tube is the active reaction site, is proposed.

CC 57-8 (Ceramics)

ST carbon **nanotube** prepn benzene pyrolysis

IT Carbon fibers, miscellaneous
RL: MSC (Miscellaneous)
(hollow **nanotubes**; pyrolytic carbon **nanotubes** prepd. by **vapor** growth from pyrolysis of benzene)

IT Thermal decomposition
(pyrolytic carbon **nanotubes** prepd. by **vapor** growth from pyrolysis of benzene)

IT Capillary tubes and channels
(**nanotubes**, pyrolytic carbon **nanotubes** prepd. by **vapor** growth from pyrolysis of benzene)

IT 7440-44-0P, Carbon, preparation
RL: PEP (Physical, engineering or chemical process); SPN (Synthetic preparation); TEM (Technical or engineered material use); PREP (Preparation); PROC (Process); USES (Uses)
(**nanotubes**; pyrolytic carbon **nanotubes** prepd. by **vapor** growth from pyrolysis of benzene)

IT 7440-44-0P, Carbon, preparation
RL: PEP (Physical, engineering or chemical process); SPN (Synthetic preparation); TEM (Technical or engineered material use); PREP (Preparation); PROC (Process); USES (Uses)
(**nanotubes**; pyrolytic carbon **nanotubes** prepd. by **vapor** growth from pyrolysis of benzene)

□□FILE COMPENDEX ENTERED AT

=> d L100 1,2,5,6,8,9,13,14 all

L100 ANSWER 1 OF 15 COMPENDEX COPYRIGHT 2003 EEI
AN 2003(14):5396 COMPENDEX
TI Atomic force microscopy of nickel dot arrays with tuning fork and **nanotube** probe.
AU Lin, Xiwei (Department of Physics and Astronomy Northwestern University, Evanston, IL 60208, United States); Dravid, Vinayak P.; Rozhok, S.; Jung, S.; Chandrasekhar, V.
SO Journal of Vacuum Science and Technology B: Microelectronics and Nanometer Structures v 21 n 1 SPEC. January/February 2003 2003.p 323-325
CODEN: JVTBD9 ISSN: 0734-211X
PY **2003**
DT Journal
TC Experimental
LA English
AB A combination of a tuning fork and a carbon **nanotube** mounted to the end of commercial **cantilever** provides 26% better resolution compared to regular commercial **cantilevers**. It is shown that the use of a tuning fork and carbon **nanotube** opens new possibilities in the study of objects in different environments.(Edited abstract) 14 Refs.
CC 804.2 Inorganic Components; 741.3 Optical Devices and Systems; 802.3 Chemical Operations; 931.2 Physical Properties of Gases, Liquids and Solids; 801.4 Physical Chemistry; 931.3 Atomic and Molecular Physics
CT *Carbon **nanotubes**; Chemical modification; Transmission electron microscopy; Scanning electron microscopy; Van der Waals forces; Electron beam **lithography**; Atomic force microscopy
ST Nickel dot arrays; Scanning force microscopy; Multiwalled carbon **nanotube**

L100 ANSWER 2 OF 15 COMPENDEX COPYRIGHT 2003 EEI
AN 2002(46):5525 COMPENDEX
TI Metrology, inspection, and process control for **microlithography** XVI.
MT Metrology, Inspection, and Process Control for Microlithography XVI.
MO SPIE
ML Santa Clara, CA, United States
MD 04 Mar 2002-07 Mar 2002
SO Proceedings of SPIE - The International Society for Optical Engineering v 4689 I 2002. 659p
CODEN: PSISDG ISSN: 0277-786X
PY **2002**
MN 60178
DT Conference Proceedings
TC Theoretical; Experimental
LA English
AB The proceedings contains 64 papers from the Conference on Metrology, Inspection, and Process Control for **Microlithography** XVI. Topics discussed include: three-dimensional modeling of wafer inspection schemes for sub-70-nm **lithography**; contamination inspection of embedded phase-shift masks; using carbon **nanotube cantilevers** in scanning probe metrology; modeling resist heating in mask fabrication using a multilayer Green's function approach; metrology of optical constants for sub-200-nm **lithographic** films; influence of coma effect on scanner overlay; optimum sampling for characterization of systematic variation in photolithography; and compact formulation of mask

error factor for critical dimension control in optical **lithography**
.(Edited abstract)
CC 714.2 Semiconductor Devices and Integrated Circuits; 713 Electronic
Circuits; 712.1 Semiconducting Materials; 931.3 Atomic and Molecular
Physics; 731 Automatic Control Principles and Applications; 703.1 Electric
Networks
CT *Nanotechnology; VLSI circuits; Optical variables measurement;
Transistors; Photolithography; Carbon **nanotubes**; Masks; Phase
shift; Imaging techniques; Microelectronics; Semiconductor materials;
Electron beams; Process control
ST Nanoelectronics; Semiconductor foundries; Electron-beam metrology;
Numerical apertures (NA); Attenuated phase shift masks (ATTPSM); Optical
metrology; Photomasks; Phase shift masks; Semiconductor metrology; EiRev

L100 ANSWER 5 OF 15 COMPENDEX COPYRIGHT 2003 EEI
AN 2002(11):1199 COMPENDEX
TI Electric-field-enhanced growth of carbon **nanotubes** for scanning
probe **microscopy**.
AU Ono, Takahito (Dept. of Mechatronics/Precision Eng. Graduate School of
Engineering Tohoku University, Sendai 980-8579, Japan); Miyashita,
Hidetoshi; Esashi, Masayoshi
SO Nanotechnology v 13 n 1 February 2002 2002.p 62-64
CODEN: NNOTER ISSN: 0957-4484
PY **2002**
DT Journal
TC Theoretical; Experimental
LA English
AB The influence of an electric field on carbon **nanotube** (
CNT) growth using hot-filament chemical vapour deposition is
investigated. Acetylene (C2H2) gas diluted with hydrogen is used as the
source gas for the growth of **CNTs**, and a bias voltage of -300 V
is applied to the sample stage during growth. The silicon substrate onto
which the **CNT** is grown is prepared by sputtering a thin
catalysed metal (Ni) film onto the surface, and the **CNT**
is selectively grown from the tip of a silicon protrusion on the
substrate. It is found that the application of a high electrostatic field
with a negative substrate bias enhances the growth of **CNTs** in
this situation. This effect is successfully applied to the fabrication of
a **CNT** tip supported by a silicon **cantilever** for use in
scanning probe **microscopy**. 13 Refs.
CC 933.1 Crystalline Solids; 802.3 Chemical Operations; 804.1 Organic
Components; 701.1 Electricity: Basic Concepts and Phenomena; 813.1 Coating
Techniques; 802.2 Chemical Reactions
CT *Carbon **nanotubes; Microscopic** examination; Chemical
vapor deposition; Thin films; Hydrogen; Electric field effects;
Sputtering; Growth (materials); Acetylene; Substrates; Metallic films
ST Scanning probe **microscopy**
ET C*H; C2H; C cp; cp; H cp; Ni

L100 ANSWER 6 OF 15 COMPENDEX COPYRIGHT 2003 EEI
AN 2001(45):4383 COMPENDEX
TI Nanotechnology: Science and technology of nonostructures.
MT Trends in Nanotechnology (TNT 2000) Conference.
ML Toledo, Spain
MD 12 Oct 2000-16 Oct 2000
SO Nanotechnology v 12 n 2 June 2001 2001. 187p
CODEN: NNOTER ISSN: 0957-4484
PY **2001**
MN 58623
DT Conference Proceedings

TC Theoretical; Experimental
LA English
AB The proceedings contains 23 papers from the 2001 Conference on Nanotechnology: Science and Technology of Nanostructures. The topics discussed include: trends in nanoelectronics; nanoimprint **lithography**; second-harmonic generation and shielding effects of alkaliclusters on ultrathin organic films; heterostructure nanowires; production of carbon **nanotubes**; nanoscale Coulomb blockade memory and logic devices; and magnetic qubits as hardware for quantum computers.(Edited abstract)
CC 714.2 Semiconductor Devices and Integrated Circuits; 701.1 Electricity: Basic Concepts and Phenomena; 933.1 Crystalline Solids; 641.1 Thermodynamics; 722.1 Data Storage (Equipment and Techniques); 712.1 Semiconducting Materials
CT *Nanotechnology; Heterojunctions; Carbon **nanotubes**; Thermal expansion; Charge carriers; Shot noise; Magnetic storage; Nanostructured materials; Ultrathin films; Current voltage characteristics; CMOS integrated circuits; **Lithography**; Electric conductance
ST Nanoelectronics; Nanoimprint **lithography**; Resonating **cantilevers**; Single electron transistors (SET); Ultrathin organic films; Gate **oxides**; Scanning force microscopy (SFM); Nanometric devices; Conductance histograms (CH); EiRev

L100 ANSWER 8 OF 15 INSPEC COPYRIGHT 2003 IEE
AN 2002:7425704 INSPEC DN B2002-12-2575-003
TI MEMS technology: optical application, medical application and SOC application.
AU Esashi, M. (New Ind. Creation Hatchery Center (NICHe), Tohoku Univ., Sendai, Japan)
SO 2002 Symposium on VLSI Technology. Digest of Technical Papers (Cat. No.01CH37303)
Piscataway, NJ, USA: IEEE, **2002**. p.6-9 of xii+228 pp. 16 refs.
Also available on CD-ROM in PDF format
Conference: Honolulu, HI, USA, 11-13 June 2002
Price: CCCC 0-7803-7312-X/02/$17.00
ISBN: 0-7803-7312-X
DT Conference Article
TC Application; General Review; Practical; Experimental
CY United States
LA English
AB MEMS (micro electromechanical systems) have been developed based on silicon bulk micromachining. Wafer process packaging was applied to an electrostatically levitated rotational gyroscope and a micro relay. High density electrical feedthrough made by glass deep RIE and metal electroplating enabled an array MEMS as multiprobe data storage and contactor for LSI probing. Fine diameter fiber optic sensors for pressure and NSOM (near field scanning optical microscope) sensor applications were developed. The hydrogen storage capacity of a carbon **nanotube** was measured using the resonant frequency shift of a thin silicon **cantilever**.
CC B2575 Micromechanical device technology; B7230M Microsensors; B8380M Microactuators; B7320V Pressure and vacuum measurement; B2550E Surface treatment (semiconductor technology); B0170J Product packaging; B2570A Semiconductor integrated circuit design, layout, modelling and testing; B7230E Fibre optic sensors; B2180B Relays and switches; B2230F Fullerene, nanotube and related devices; B7510J Optical and laser radiation (biomedical imaging/measurement)
CT BIOLOGICAL TECHNIQUES; BIOMEDICAL EQUIPMENT; BLOOD PRESSURE MEASUREMENT; CARBON **NANOTUBES**; ELECTRIC SENSING DEVICES; FIBRE OPTIC SENSORS; GYROSCOPES; INTEGRATED CIRCUIT TESTING; LARGE SCALE INTEGRATION;

MICROACTUATORS; MICROMACHINING; MICROMECHANICAL RESONATORS; MICROSENSORS; OPTICAL MICROSCOPY; PLASMA MATERIALS PROCESSING; PRESSURE SENSORS; RELAYS; SEMICONDUCTOR DEVICE PACKAGING; SPUTTER **ETCHING**
ST MEMS technology; optical application; medical application; SoC application; micro electromechanical systems; silicon bulk micromachining; wafer process packaging; electrostatically levitated rotational gyroscope; micro relay; high density electrical feedthrough; glass deep RIE; metal electroplating; array MEMS multiprobe data storage; array MEMS contactor; LSI probing; fiber optic sensors; pressure sensors; NSOM probe; near field scanning optical microscope; hydrogen storage capacity; **carbon nanotube**; resonant frequency shift; **thin silicon cantilever** ; fiber optic blood vessel pressure sensor; Si; H2; C
CHI Si sur, Si el; H2 el, H el; C el
ET C*S; SoC; S cp; cp; C cp; Si; H2; C; H

L100 ANSWER 9 OF 15 INSPEC COPYRIGHT 2003 IEE
AN 2002:7380159 INSPEC DN A2002-21-8115H-001; B2002-10-0520F-068
TI Growth of suspended carbon **nanotube** networks on 100-nm-scale silicon pillars.
AU Homma, Y.; Kobayashi, Y.; Ogino, T. (NTT Basic Res. Labs., Nippon Telegraph & Telephone Corp., Kanagawa, Japan); Yamashita, T.
SO Applied Physics Letters **(16 Sept. 2002)** vol.81, no.12, p.2261-3.
10 refs.
Doc. No.: S0003-6951(02)03937-2
Published by: AIP
Price: CCCC 0003-6951/2002/81(12)/2261(3)/$19.00
CODEN: APPLAB ISSN: 0003-6951
SICI: 0003-6951(20020916)81:12L.2261:GSCN;1-2
DT Journal
TC Experimental
CY United States
LA English
AB We investigated carbon **nanotube** growth by means of methane chemical vapor deposition on ultrafine silicon patterns prepared by synchrotron-radiation lithography. Grown **nanotubes** formed suspended bridges between pillars when pillar spacing was comparable to pillar height. Network-like interconnections were obtained on pillar arrays. Nearest-neighbor bridging accounted for more than 80% of all the bridging **nanotubes**. The self-directed growth between neighboring pillars may be explained by the swing of the **nanotube cantilever** which contacts a **catalyst** particle in liquid phase as the **nanotube** grows. These results confirm the possibility of self-assembled wiring of nanostructures.
CC A8115H Chemical vapour deposition; A6148 Structure of fullerenes and fullerene-related materials; A6855 Thin film growth, structure, and epitaxy; B0520F Chemical vapour deposition; B2520C Elemental semiconductors; B2550G Lithography (semiconductor technology)
CT CARBON **NANOTUBES**; CHEMICAL VAPOUR DEPOSITION; ELEMENTAL SEMICONDUCTORS; SELF-ASSEMBLY; SILICON; X-RAY LITHOGRAPHY
ST **suspended C nanotube networks growth**; pillars; methane chemical vapor deposition; synchrotron-radiation lithography; suspended bridges; network-like interconnections; nearest-neighbor bridging; ultrafine patterns; self-directed growth; self-assembled wiring; CVD; 100 nm; Si; C
CHI Si sur, Si el; C el
PHP size 1.0E-07 m
ET C; Si

L100 ANSWER 13 OF 15 INSPEC COPYRIGHT 2003 IEE
AN 2002:7321398 INSPEC DN B2002-08-2550N-012
TI Nano-processing using carbon **nano tube** probes and its

device applications.
AU Matsumoto, K.; Gotoh, Y. (Nat. Inst. of Adv. Ind. Sci. & Technol., Ibaraki, Japan)
SO 2001 International Semiconductor Device Research Symposium. Symposium Proceedings (Cat. No.01EX497)
Piscataway, NJ, USA: IEEE, **2001**. p.354-7 of xiv+669 pp. Also available on CD-ROM in PDF format
Conference: Washington, DC, USA, 5-7 Dec 2001
Sponsor(s): IEEE; Electron Devices Soc.; Army Res. Office; NSF; Army Res. Lab.; NASA; Electr. & Comput. Eng. Dept.; Univ. Maryland
ISBN: 0-7803-7432-0
DT Conference Article
TC Application; New Development; Practical
CY United States
LA English
AB The new advanced technology which can grow the **single** wall carbon **nanotube** directly to the silicon **tip** is applied in the following three nano-electron devices. 1) The **single** wall carbon **nanotube** was used as a sharp AFM **cantilever** to improve the resolution of AFM image. The surface of gold(Au) and its cross section on the silicon substrate were observed using the carbon **nanotube** AFM **cantilever** and conventional AFM **cantilever**. 2) The **single** wall carbon **nanotube** with a diameter of 1 2nm was used as a sharp AFM **cantilever** and anodized the surface of the titanium (Ti) to form the narrow oxidized titanium (TiOx) tunnel junction of 5nm for the room temperature planar type single electron transistor(SET). The fabricated SET shows the room temperature Coulomb diamond. 3) The **single** wall carbon **nanotube** was used as an ultra-sharp field emitter. The emitter has 10 to 20 times smaller diameter than the conventional silicon field emitter formed by the selective **etching**. The threshold voltage of the field emission for the carbon **nanotube** field emitter becomes as small as 10V which is 10 50 times smaller than the conventional silicon **tip** field emitter because of the smaller diameter of the carbon **nanotube** emitter.
CC B2550N Nanometre-scale semiconductor fabrication technology; B2230F Fullerene, nanotube and related devices; B0587 Fullerenes, carbon nanotubes, and related materials (engineering materials science)
CT ATOMIC FORCE MICROSCOPY; CARBON **NANOTUBES**; ELEMENTAL SEMICONDUCTORS; GOLD; NANOTECHNOLOGY; SILICON; SINGLE ELECTRON TRANSISTORS; TITANIUM COMPOUNDS
ST **carbon nano tube probes**; AFM image; Au surface; silicon substrate; **nanotube AFM cantilever**; Ti; TiOx tunnel junction; single electron transistor; room temperature Coulomb diamond; ultra-sharp field emitter; **selective etching**; threshold voltage; field emission; threshold voltage 10V; 10 V; Au; TiO; Si
CHI Au sur, Au el; TiO int, Ti int, O int, TiO bin, Ti bin, O bin; Si sur, Si el
PHP voltage 1.0E+01 V
ET Au; Ti; V; O*Ti; TiOx; Ti cp; cp; O cp; TiO; Si; O

L100 ANSWER 14 OF 15 INSPEC COPYRIGHT 2003 IEE
AN 2002:7229808 INSPEC DN A2002-10-6148-002
TI Electric-field-enhanced growth of carbon **nanotubes** for scanning probe **microscopy**.
AU Ono, T.; Miyashita, H.; Esashi, M. (Dept. of Mechatronics & Precision Eng., Tohoku Univ., Sendai, Japan)
SO Nanotechnology **(Feb. 2002)** vol.13, no.1, p.62-4. 13 refs.
Doc. No.: S0957-4484(02)26815-4
Published by: IOP Publishing

Price: CCCC 0957-4484/02/010062+03$30.00
CODEN: NNOTER ISSN: 0957-4484
SICI: 0957-4484(200202)13:1L.62:EFEG;1-1
DT Journal
TC Application; Experimental
CY United Kingdom
LA English
AB The influence of an electric field on carbon **nanotube** (**CNT**) growth using hot-filament chemical vapour deposition is investigated. Acetylene (C2H2) gas diluted with hydrogen is used as the source gas for the growth of **CNTs**, and a bias voltage of -300 V is applied to the sample stage during growth. The silicon substrate onto which the **CNT** is grown is prepared by sputtering a thin **catalysed** metal (Ni) film onto the surface, and the **CNT** is selectively grown from the tip of a silicon protrusion on the substrate. It is found that the application of a high electrostatic field with a negative substrate bias enhances the growth of **CNTs** in this situation. This effect is successfully applied to the fabrication of a **CNT** tip supported by a silicon **cantilever** for use in scanning probe **microscopy**.
CC A6148 Structure of fullerenes and fullerene-related materials; A0779 Scanning probe microscopy and related techniques; A8115H Chemical vapour deposition
CT CARBON **NANOTUBES**; CHEMICAL VAPOUR DEPOSITION; ELECTRIC FIELD EFFECTS; SCANNING PROBE **MICROSCOPY**
ST electric field; **carbon nanotube growth**; **scanning probe microscopy**; hot-filament chemical vapour deposition; silicon substrate; **sputtered thin film nickel catalyst**; **silicon cantilever**; -300 V; C; Si; Ni
CHI C el; Si sur, Si el; Ni el
PHP voltage -3.0E+02 V
ET C*H; C2H2; C cp; cp; H cp; Ni; C; Si

=> d L100 4, 11, 15 all

L100 ANSWER 4 OF 15 COMPENDEX COPYRIGHT 2003 EEI
AN 2002(29):1608 COMPENDEX
TI Growth of carbon **nanotubes** by thermal and plasma chemical vapour deposition processes and applications in **microscopy**.
AU Delzeit, Lance (NASA Ames Research Center, Moffett Field, CA 94035, United States); Nguyen, Cattien V.; Stevens, Ramsey M.; Han, Jie; Meyyappan, M.
SO Nanotechnology v 13 n 3 June 2002 2002.p 280-284
CODEN: NNOTER ISSN: 0957-4484
PY **2002**
DT Journal
TC Theoretical; Experimental
LA English
AB **Single**-walled carbon **nanotubes** (**SWNTs**) are grown from a methane feedstock by thermal chemical vapour deposition (CVD). An ethylene-hydrogen plasma generated in an inductively coupled plasma reactor primarily yields multi-walled carbon **nanotubes** and thicker fibres. In both cases, an iron **catalyst** layer and an aluminium underlayer are deposited by ion beam sputtering onto silicon wafers for the growth of carbon **nanotubes** (**CNTs**). The plasma process provides well-aligned multi-walled **nanofibres** useful for fabrication of electrodes and sensors and further tip functionalization whereas thermal CVD produces a mat of **SWNT** ropes. In addition, **CNTs** grown at the tips of silicon **cantilevers** are demonstrated to be ideal for high-resolution

imaging of biological samples and simulated Mars dust grains using **atomic force microscopy**. 30 Refs.

CC 933.1 Crystalline Solids; 804.1 Organic Components; 802.2 Chemical Reactions; 932.3 Plasma Physics; 932.1 High Energy Physics; 539.3 Metal Plating

CT *Carbon **nanotubes**; Imaging techniques; **Atomic force microscopy**; Ion beams; Sputtering; Electrodes; Silicon; Methane; Chemical vapor deposition; Inductively coupled plasma; Fibers

ST **Single**-walled carbon **nanotubes** (**SWNT**)

L100 ANSWER 11 OF 15 INSPEC COPYRIGHT 2003 IEE

AN 2002:7364859 INSPEC DN A2002-20-8115H-027

TI Growth of carbon **nanotubes** by thermal and plasma chemical vapour deposition processes and applications in **microscopy**.

AU Delzeit, L.; Nguyen, C.V.; Stevens, R.M.; Jie Han; Meyyappan, M. (NASA Ames Res. Center, Moffett Field, CA, USA)

SO Nanotechnology **(June 2002)** vol.13, no.3, p.280-4. 30 refs.
Doc. No.: S0957-4484(02)30996-6
Published by: IOP Publishing
Price: CCCC 0957-4484/02/030280+05$30.00
CODEN: NNOTER ISSN: 0957-4484
SICI: 0957-4484(200206)13:3L.280:GCNT;1-I
Conference: Trends in Nanotechnology Conference (TNT2001). Segovia, Spain, 3-7 Sept 2001

DT Conference Article; Journal

TC Application; Experimental

CY United Kingdom

LA English

AB **Single**-walled carbon **nanotubes** (**SWNTs**) are grown from a methane feedstock by thermal chemical vapour deposition (CVD). An ethylene-hydrogen plasma generated in an inductively coupled plasma reactor primarily yields multi-walled carbon **nanotubes** and thicker fibres. In both cases, an iron **catalyst** layer and an aluminium underlayer are deposited by ion beam sputtering onto silicon wafers for the growth of carbon **nanotubes** (**CNTs**). The plasma process provides well-aligned multi-walled **nanofibres** useful for fabrication of electrodes and sensors and further tip functionalization whereas thermal CVD produces a mat of **SWNT** ropes. In addition, **CNTs** grown at the tips of silicon **cantilevers** are demonstrated to be ideal for high-resolution imaging of biological samples and simulated Mars dust grains using **atomic force microscopy**.

CC A8115H Chemical vapour deposition; A8120V Preparation of fullerenes and fullerene-related materials, intercalation compounds, and diamond; A6148 Structure of fullerenes and fullerene-related materials; A0779 Scanning probe microscopy and related techniques; A5275R Plasma applications in manufacturing and materials processing

CT **ATOMIC FORCE MICROSCOPY**; CARBON **NANOTUBES**; CHEMICAL VAPOUR DEPOSITION; PLASMA CVD

ST **carbon nanotube growth**; thermal chemical vapour deposition; plasma chemical vapour deposition; **single-walled carbon nanotube** ; **iron catalyst**; aluminium underlayer; ion beam sputtering; **silicon cantilever**; biological sample; high-resolution imaging; Mars dust grain; **multi-walled carbon nanotube**; silicon wafer; **multi-walled carbon nanofibre**; **atomic force microscopy**; C; Si; Fe; Al

CHI C el; Si sur, Si el; Fe el; Al el

ET C; Si; Fe; Al

L100 ANSWER 15 OF 15 INSPEC COPYRIGHT 2003 IEE
AN 2002:7149439 INSPEC DN A2002-04-8115H-053
TI Carbon **nanotubes** by CVD and applications.
AU Cassell, A.; Delzeit, L.; Nguyen, C.; Stevens, R.; Han, J.; Meyyappan, M.
(Ames Res. Center, Iowa State Univ., Ames, IA, USA)
SO Journal de Physique IV (Proceedings) **(Aug. 2001)** vol.11, no.3,
p.Pr3-401-9. 30 refs.
Published by: EDP Sciences
CODEN: JPICEI ISSN: 1155-4339
SICI: 1155-4339(200108)11:3L.pr3:CNA;1-#
DT Journal
TC Experimental
CY France
LA English
AB Carbon **nanotube** (**CNT**) exhibits extraordinary mechanical and unique electronic properties and offers significant potential for structural, sensor, and nanoelectronics applications. An overview of **CNT**, growth methods, properties and applications is provided. Single-wall, and multi-wall **CNTs** have been grown by chemical vapor deposition. **Catalyst** development and optimization has been accomplished using combinatorial optimization methods. **CNT** has also been grown from the tips of silicon **cantilevers** for use in **atomic force microscopy**.
CC A8115H Chemical vapour deposition; A6148 Structure of fullerenes and fullerene-related materials; A6855 Thin film growth, structure, and epitaxy; A6820 Solid surface structure; A8265J Heterogeneous catalysis at surfaces and other surface reactions
CT **ATOMIC FORCE MICROSCOPY**; CARBON **NANOTUBES**; **CATALYSTS**; CHEMICAL VAPOUR DEPOSITION; OPTIMISATION
ST **C nanotubes**; **SWCNT**; MWCNT; CVD; **CNT**; growth methods; single-wall tubes; multiwall tubes; chemical vapor deposition; **catalyst**; combinatorial optimization; **atomic force microscopy**; AFM; C; Si
CHI C el; Si el
ET C; Si

TI Carbon **nanotubes** by CVD and applications.

L100 ANSWER 8 OF 15 INSPEC COPYRIGHT 2003 IEE
TI MEMS technology: optical application, medical application and SOC application.

L100 ANSWER 9 OF 15 INSPEC COPYRIGHT 2003 IEE
TI Growth of suspended carbon **nanotube** networks on 100-nm-scale silicon pillars.

L100 ANSWER 10 OF 15 INSPEC COPYRIGHT 2003 IEE
TI Electron-beam-induced deposition with carbon **nanotube** emitters.

L100 ANSWER 11 OF 15 INSPEC COPYRIGHT 2003 IEE
TI Growth of carbon **nanotubes** by thermal and plasma chemical vapour deposition processes and applications in **microscopy**.

L100 ANSWER 12 OF 15 INSPEC COPYRIGHT 2003 IEE
TI Micro-nanosystems by bulk silicon micromachining.

L100 ANSWER 13 OF 15 INSPEC COPYRIGHT 2003 IEE
TI Nano-processing using carbon **nano tube** probes and its device applications.

L100 ANSWER 14 OF 15 INSPEC COPYRIGHT 2003 IEE
TI Electric-field-enhanced growth of carbon **nanotubes** for scanning probe **microscopy**.

L100 ANSWER 15 OF 15 INSPEC COPYRIGHT 2003 IEE
TI Carbon **nanotubes** by CVD and applications.

=> file wpix, japio

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=> d L145 1-3 ti

L145 ANSWER 1 OF 3 WPIX (C) 2003 THOMSON DERWENT
TI High resolution spectroscopic information obtaining system using scanning Raman microscope.

L145 ANSWER 2 OF 3 WPIX (C) 2003 THOMSON DERWENT
TI Nano-**atomic force microscope** for rapid and sensitive surface interatomic or intermolecular force measurement.

L145 ANSWER 3 OF 3 WPIX (C) 2003 THOMSON DERWENT
TI Carbon **nanotube** device, especially an electron emitter, and method of manufacture.

=> d L145 2,3 all

L145 ANSWER 2 OF 3 WPIX (C) 2003 THOMSON DERWENT

AN 2000-024613 [03] WPIX
DNN N2000-018333 DNC C2000-006348
TI Nano-**atomic force microscope** for rapid and sensitive surface interatomic or intermolecular force measurement.
DC L03 S03 U12 V05
IN FUCHS, H; SIMON, U
PA (FUCH-I) FUCHS H
CYC 1
PI DE 19822634 A1 19991125 (200003)* 5p H01J037-28
ADT DE 19822634 A1 DE 1998-19822634 19980520
PRAI DE 1998-19822634 19980520
IC ICM H01J037-28
ICS H01L051-30
AB DE 19822634 A UPAB: 20000118

NOVELTY - An **atomic force microscope** (AFM) has a **nanotube cantilever** and a single electron transistor (SET) read sensor.

DETAILED DESCRIPTION - A **force microscope** has a **cantilever** and a read sensor for detection of **cantilever** deflection, the **cantilever** comprising a single or **multiple** layer **nanotube**. INDEPENDENT CLAIMS are also included for the following:

(a) a nano-AFM as described above, having **nanotubes** of transition metal **oxides** such as VOx or of BN; and

(b) SETs which are used as read sensors for the above **force microscope** and which employ chips of ligand-stabilized metal or semiconductor clusters, SiO, carboranes (or their derivatives) or fullerenes.

USE - As an SET-type nano-**atomic force microscope** operating in a static, quasi-static or especially dynamic mode for surface interatomic or intermolecular force measurement.

ADVANTAGE - The **cantilever** provides a characteristic frequency of the order of a few hundred MHz to allow more rapid and sensitive surface measurement than that achieved with conventional micromechanical **cantilevers** and can be used directly as a measuring tip of an AFM. The SET sensor allows extremely rapid switching and the direct detection of single electrons.

DESCRIPTION OF DRAWING(S) - The figure shows a schematic view of a nano-AFM.

nanotube 1
surface structure to be measured 4
SET sensor 6
Dwg.1/1
FS CPI EPI
FA AB; GI
MC CPI: L04-E01
EPI: S03-E02F3; U12-D02A9; V05-F01A5; V05-F04B6A; V05-F08A; V05-F08B

L145 ANSWER 3 OF 3 WPIX (C) 2003 THOMSON DERWENT
AN 1999-256644 [22] WPIX
DNN N1999-191213 DNC C1999-075309
TI Carbon **nanotube** device, especially an electron emitter, and method of manufacture.
DC E36 F01 L03 S02
IN DEN, T; IWASAKI, T
PA (CANO) CANON KK
CYC 26
PI EP 913508 A2 19990506 (199922)* EN 30p D01F009-127
R: AL AT BE CH CY DE DK ES FI FR GB GR IE IT LI LT LU LV MC MK NL PT RO SE SI

JP 11194134 A 19990721 (199939) 18p G01N037-00
ADT EP 913508 A2 EP 1998-308872 19981029; JP 11194134 A JP 1998-276426 19980914
PRAI JP 1998-276426 19980914; JP 1997-298373 19971030
IC ICM D01F009-127; G01N037-00
ICS G01B007-34; H01J001-30; H01J009-02; H01L049-00
ICA C01B031-02; H01B001-04; H01L029-06
AB EP 913508 A UPAB: 20011203

NOVELTY - Carbon **nanotube** device comprises a carbon **nanotube** bound at its root end to a conductive surface and surrounded at its root end by a wall.

DETAILED DESCRIPTION - A carbon **nanotube** device comprises a carbon **nanotube** bounded at one end to a conductive substrate, the root of the **nanotube** where it is bounded to the substrate being surrounded by a wall. Preferably the **nanotube** is grown from a catalyst particle deposited on the conductive substrate which is in direct conductive contact with the substrate, or forms a tunnel junction with the substrate via an insulating layer. Method for forming the device comprises: forming carbon **nanotube** binding sites isolated from each other by walls on a conductive substrate; and growing the **nanotubes** at the sites.

USE - As an electron emitting device (claimed) for a display device, CRT etc; or as a quantum effect device, micro-machine, bio-device or as an **atomic force microscope** probe or scanning type tunnel microscope probe.

ADVANTAGE - The device has high directivity and provides high electron emission.

DESCRIPTION OF DRAWING(S) - The drawing shows a carbon **nanotube** device of the invention.

Support substrate 20
Conductive surface layer 21
Catalytic fine particle 23
Carbon **nanotube** 24
Wall surrounding the root of the **nanotube** 22

Dwg.5A/15
FS CPI EPI
FA AB; GI; DCN
MC CPI: E10-J01; E10-J02D1; E31-A04; E31-N03; E31-N05B; E35-U05; E35-W; F01-D09A; L03-C02
EPI: S02-A02X